CONSTRUCTION TRENDS

Notes on significant movements in the construction industry

Record 1941 construction produced 14,574 projects

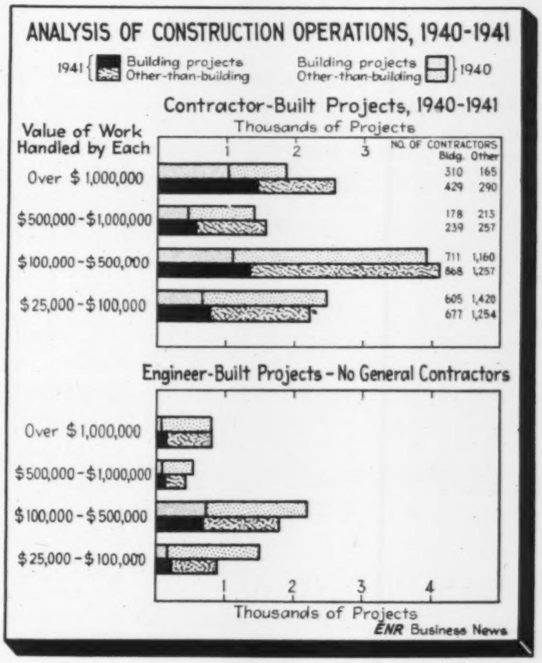
In 1941, the greatest year in construction history, 14,574 projects of all types were constructed; 10,620 were contractor-built, and 3,954 were built by engineers without general contractors. Contractor-built projects showed an 8½ percent increase over the number reported in 1940, but engineer-built jobs without contractors decreased 22½ percent. The net result was a 2 percent decline in the overall project total as compared with the preceding year, but the average project value increased from $268,000 to $403,000.

Of the 10,620 contractor-built projects, 4,268 were engineered buildings, requiring 2,324 contractors; and 6,352 were other-than-building jobs, with 3,072 contractors participating.

Almost 40 percent of the contractor-constructed projects were built by contractors whose annual volume of business was from $100,000 to $500,000; 24 percent were in the million-dollar-or-over bracket; 21 percent in the $25,000 to $100,000 class; and 15 percent in the $500,000 to $1,000,000 range.

Other-than-building work accounted for 2,793, or 71 percent of the 3,954 projects erected by engineers without general contractors, and the balance, 1,161, were engineered buildings.

Of the owner- or engineer-built projects, 1,808 were in the $100,000 to $500,000 range; 905 were in the $25,000 to $100,000 class; 798 in the million-dollar-or-over bracket; and 414 in the $500,000 to $1,000,000 range. Decreases from last year were recorded in all the size ranges, except in the million-dollar-or-over class which produced 798 projects in 1941, just six more than in 1940.



NUMBER OF CONTRACTORS REPORTED BY *ENGINEERING NEWS-RECORD*—1941–'40

		OTHER THAN BUILDING		**BUILDING**		**TOTAL**		**Number of PROJECTS Built by Engineers without General Contractors**		
Value of Work Handled By Each Contractor		**No. of Contractors**	**No. of Projects**	**No. of Contractors**	**No. of Projects**	**No. of Contractors**	**No. of Projects**	**Other Than Building**	**Building**	**Total**
a. Over $1,000,000	1941	290	1,120	429	1,470	719	2,590	665	133	798
	1940	165	859	310	1,023	475	1,882	708	84	792
b. $500,000—1,000,000	1941	257	1,034	239	558	496	1,592	302	112	414
	1940	213	967	178	443	391	1,410	442	97	539
c. $100,000—$500,000	1941	1,257	2,723	868	1,365	2,125	4,088	1,119	689	1,808
	1940	1,160	2,810	711	1,101	1,871	3,916	1,504	696	2,200
d. $25,000—$100,000	1941	1,254	1,461	677	749	1,931	2,210	702	203	905
	1940	1,420	1,761	605	661	2,025	2,442	1,344	174	1,518
Amount not reported	1941	14	14	111	126	125	140	5	24	29
	1940	38	39	107	112	145	151	11	45	56
TOTAL	1941	3,072	6,352	2,324	4,268	5,396	10,620	2,793	1,161	3,954
	1940	2,996	6,436	1,911	3,340	4,907	9,781	4,009	1,096	5,101

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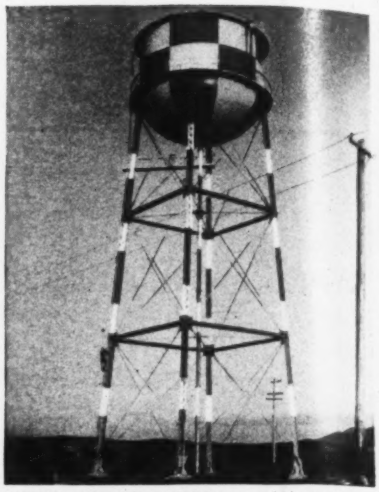
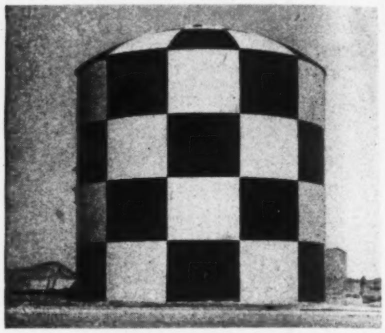
ELEVATED STEEL STORAGE TANKS
for water supply at training camps

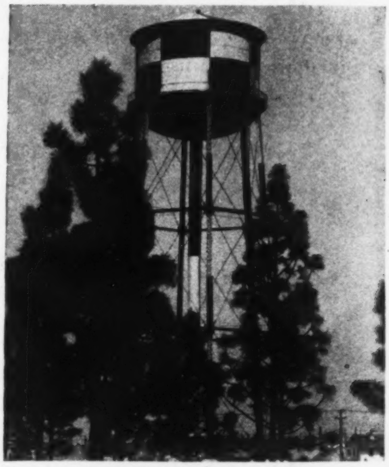
500,000-gal. water tank with ellipsoidal bottom and roof at a Southwestern air field.



100,000-gal. ellipsoidal-bottom elevated tank installed to provide gravity water pressure at a Pacific coast army camp.



750,000-gal. welded steel reservoir in the water system serving an army camp in one of the Southeastern states.



Four 300,000-gal. elevated tanks like this one were installed at widely separated points in a large Southern camp.

Our American military program is being built on a basis of strong fundamental principles. We have taken definite steps to guard the health and well-being of our men in training camps. Proven methods are also being used to protect the plants where we are producing equipment and supplies for our armed forces.

We know, from our experience in providing municipal service, that adequate water and sanitary systems go a long way in safeguarding health. The illustrations on this page show how elevated tanks and steel reservoirs are being used, as in municipal systems, to provide dependable water service at camps.

Elevated tanks similar to these are also being used to provide gravity pressure for general water service or fire protection at munitions plants, airplane factories and other vital industries. They hold a reserve above the buildings, ready to flow—any time of night or day—the instant a blaze breaks out. In some instances, flat-bottom tanks suction tanks provide a second reserve for fire pumps.

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WALDO G. BOWMAN, *Editor* **ALBERT E. PAXTON,** *Manager*

Vol. 128 MARCH 12, 1942 No. 11

THIS WEEK

• To provide the ultimate in lighting efficiency for our latest bomber assembly plants, a floor topping consisting of 1:2½ mix of white cement and white silica sand has been used as a light reflecting medium, thus eliminating many shadows underneath wings and fuselages. An efficient technique of building such floors is described on page 88 of this issue.

• Out of this war will come many ideas—sound, practical ideas for the designing engineer—that will serve us well in peace times. The idea of welded tubular steel members for bridge structures is but one. In this issue an analytical study of the practical and ecomonic use of such members is presented on page 108.

• In these days when manpower is at a premium—when "we have never been called upon to do so much in so short a time"—accidents on construction jobs are suicidal. On one recent ordnance plant job 5,775,000 man-hours were accumulated without a single lost-time accident. The methods used by the contractor to sell his force on accident prevention are outlined on page 94.

THINGS TO COME

• No single phase of our feverish war construction program has been tackled with more vigor and ingenuity than that displayed by engineers on the building of Navy drydocks. Beside completing many jobs in record-breaking time, these engineers have set precedents useful in other types of construction. One of, if not the most outstanding developments, is the method for building an entire concrete drydock under water. This will be described in the Mar. 26 issue.

• One does not have to look far to see the tremendous influence the war is having upon industrial plant design. Breaking away from the traditional use of steel, an all-concrete cement mill has recently been built. It is 470 x 80 ft. in plan and 65 ft. high with a concrete arched roof. The method of construction is even more interesting than the design. This project will be described in the Mar. 26 issue.

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Number of copies of this issue printed: 36,906

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Your nearby Ryerson plant carries reinforcing bars, wire mesh, structurals, roofing... and practically every form of construction steel and allied products . . . in stock for immediate shipment.

The demands of wartime, naturally, have limited our stock, but we are in a position to furnish steel for the war program and essential industries.

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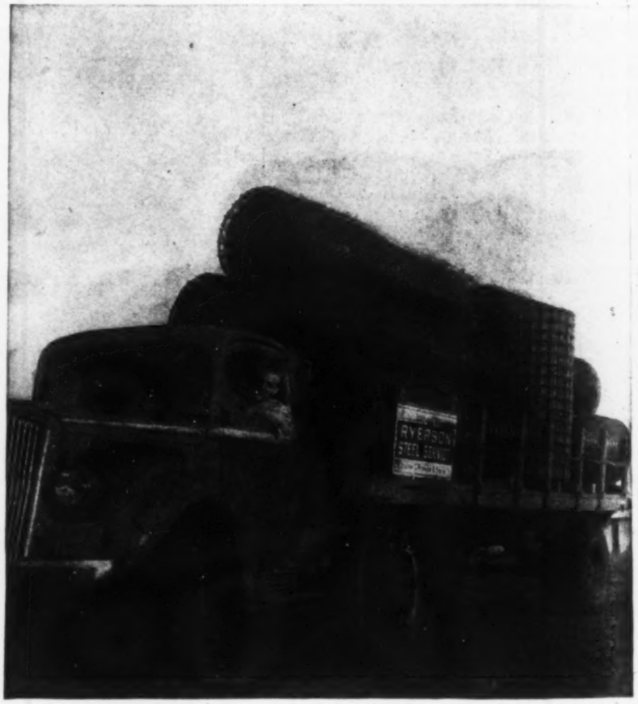

Prompt Deliveries to meet your day-to-day job needs and keep materials coming on schedule.

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MONTHLY CONSTRUCTION BUSINESS SUMMARY

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	February 1941	February 1942	% Change	Two Months 1941	Two Months 1942	% Change
Total Construction	$424,269	$634,823	+50.0	$1,008,818	$1,263,603	+25.0
Private Construction	137,920	69,284	−50.0	312,599	120,405	−62.0
Public Construction	286,349	565,539	+97.5	696,219	1,143,198	+64.0
Federal	193,960	526,187	+171.0	468,819	1,023,287	+118.0
Total New Productive Capital	$585,123	$812,549	+39.0	$679,111	$1,372,463	+102.0
Private Investment	50,395	18,065	−64.0	130,720	116,679	−11.0
Federal (non-federal work)	25,728	2,529	−90.0	39,391	13,829	−65.0
Federal (federal work)	509,000	791,955	+56.0	509,000	1,241,955	+144.0
FHA Mortgages Selected for Appraisal (Title II)	$99,705	$61,931*	−38.0	$185,698	$121,364*	−34.5

* *Preliminary.*

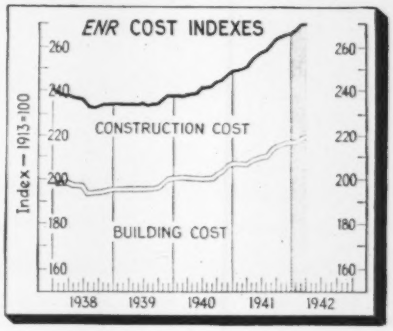
CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	March 1941	March 1942	% Change	Change February to March 1941 Feb.	1941 Mar.	%	1942 Feb.	1942 Mar.	%
E N R Construction Cost Index, 1913 = 100‡	250.71	269.71	+7.6	250.50	250.71	+0.1	269.41	269.71	+0.1
E N R Building Cost Index, 1913 = 100‡	207.88	218.88	+5.3	208.42	207.88	−0.3	218.44	218.88	+0.2

‡ *Does not reflect increased costs due to more overtime, lower laber efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

	March 1941	March 1942	% Change	1941 Feb.	1941 Mar.	%	1942 Feb.	1942 Mar.	%
Common Labor	$0.716	$0.780	+8.9	$0.713	$0.716	+0.4	$0.780	$0.780	0
Skilled Labor (av. 3 trades)	1.468	1.538	+4.8	1.470	1.468	−0.1	1.536	1.538	+0.1
Bricklayers	1.561	1.638	+4.9	1.568	1.561	−0.4	1.638	1.638	0
Structural Ironworkers	1.535	1.599	+4.2	1.535	1.535	0	1.599	1.599	0
Carpenters	1.307	1.376	+5.3	1.307	1.307	0	1.370	1.376	+0.4
Cement, per bbl	$2.52	$2.60	+3.2	$2.51	$2.52	+0.4	$2.60	$2.60	0
Reinforcing steel, per cwt.	2.56	2.61	+2.0	2.53	2.56	+1.2	2.61	2.61	0
Struct. steel shapes, base	2.10	2.10	0	2.10	2.10	0	2.10	2.10	0
Sand, per ton	1.17	1.21	+3.4	1.17	1.17	0	1.21	1.21	0
Lumber, 2x4 Fir, per M ft.	40.59	47.80	+17.8	40.68	40.59	−0.2	47.57	47.80	+0.5
Lumber, 2x4 Pine, per M ft.	37.85	42.06	+11.1	38.49	37.85	−1.7	41.74	42.06	+0.8
Brick, common, per M	14.50	15.28	+5.4	14.45	14.50	+0.3	15.28	15.28	0
Ready-mixed concrete, c.y.	6.93	7.20	+3.9	6.93	6.93	0	7.20	7.20	0
Struct. clay tile, 3x12x12	74.34	75.91	+2.1	74.14	74.34	+0.3	75.83	75.91	+0.1
Paving asphalt, cars, ton	14.24	15.31	+7.5	14.24	14.24	0	15.28	15.31	+0.2



ENR INDEX NUMBERS

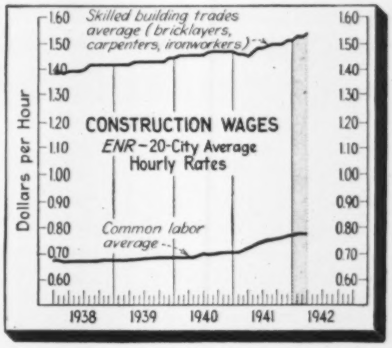
Base=100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Mar., 1942	269.71	129.65	218.88	118.32	...	...
Feb., 1942	269.41	129.51	218.44	118.08	507	222
Jan., 1942	267.63	128.65	217.12	117.37	*402	*176
Dec., 1941	266.16	127.94	216.37	116.96	217	95
Nov., 1941	266.13	127.93	216.54	117.05	282	124
Oct., 1941	264.46	127.13	215.92	116.72	263	115
Sept., 1941	263.12	126.48	214.58	116.00	419	184
Aug., 1941	260.41	125.18	212.45	114.84	434	190
July, 1941	258.18	124.11	210.22	113.64	635	278
June, 1941	256.79	123.44	209.41	113.20	492	216
May, 1941	255.55	122.84	209.24	113.11	275	121
April, 1941	252.40	121.33	208.60	112.76	322	141
Mar., 1941	250.71	120.52	207.88	112.37	386	169
Feb., 1941	250.50	120.42	208.42	112.67	374	164
1941 (Av.)	257.84	123.95	211.46	114.32	375	164
1940 (Av.)	241.96	116.31	202.81	109.64	269	118
1939 (Av.)	235.51	113.21	197.44	106.73	211	92
1938 (Av.)	235.86	113.34	196.83	106.40	197	86

**Revised.*

MATERIAL SHIPMENTS . . . BUILDING PERMITS

	February 1941	February 1942	% Change	Jan. 1942	% Change Jan.-Feb.
Lumber (% wk. seas. av. 1935–'39) N.L.M.A.	146.0	154.5	+5.8	136.0	+13.6
Steel (% operating capacity) A.I.S.I.	96.2	97.1	+1.0	97.1	0

	January 1941	January 1942	% Change	December-January 1941	December-January 1942	% Change
Fabricated Structural Steel, tons, A.I.S.C.	164,590	157,986	−4.0	176,126	157,986	−10.2
Cement, thous. bbl., U.S.B. of M	7,984	9,120	+14.3	11,511	9,120	−20.8
Building Permits, Dun & Bradstreet (,000 omitted)	$105,559	$62,209	−41.1	$93,857	$62,209	−33.7



COST OF LIVING AND EMPLOYMENT INDEXES

	January 1941	January 1942	% Change	Dec. 1942	% Change Dec.-Jan.
Cost of Living Index, N.I.C.B.	86.0	94.5	+9.9	93.2	+1.4
Rent (Housing) Index, N.I.C.B.	87.6	90.1	+2.9	89.9	+0.2
Total Employment, thous., B.L.S.	37,142	39,838	+7.2	41,073	−3.1
Construction Employment, thous., B.L.S.	1,623	1,713	+5.5	1,874	−8.6

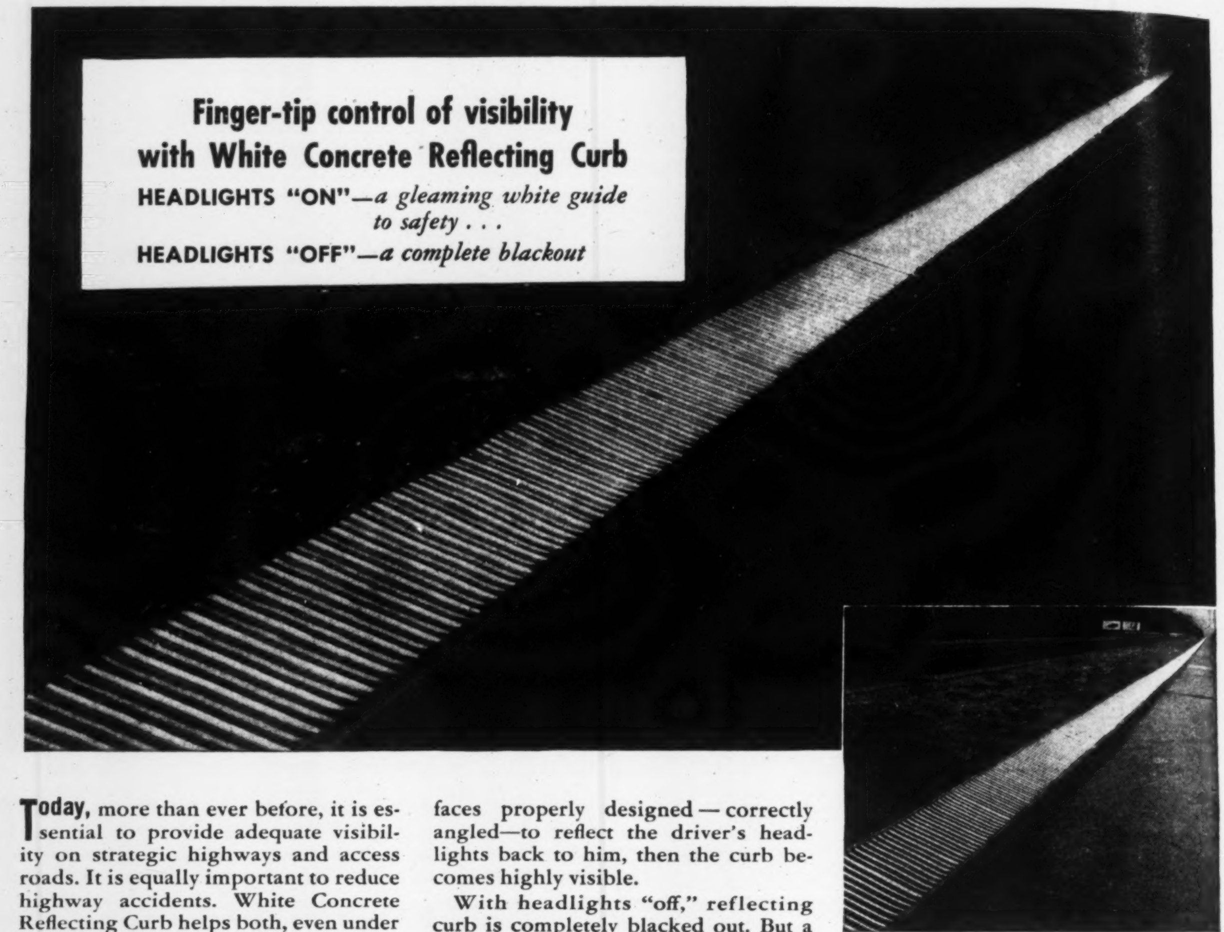
ENGINEERING CONSTRUCTION CONTRACTS——ENGINEERING NEWS-RECORD——FEBRUARY, 1942

Engineering News-Record *reports projects of the following minimum costs;—waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Four Weeks—Thousands of Dollars (000 Omitted)

Public Works	**New England**	**Middle Atlantic**	**South**	**Mid West**	**West of Mississippi**	**Far West**	**United States February 1942**	**United States Two Months 1942**	**United States Two Months 1941**	**Canada**
Waterworks	146	423	739	6,213	1,845	425	**9,791**	**16,572**	12,800	279
Sewerage	48	2,063	837	404	928	666	**4,946**	**12,580**	24,510	130
Bridges, public	131	1,973	599	1,255	617	....	**4,575**	**13,244**	22,697	30
Earthwork and waterways	561	10	30,778	....	401	1,249	**32,999**	**146,628**	23,791	216
Streets and roads	162	2,004	5,922	1,048	5,961	212	**15,309**	**48,513**	96,182	2,484
Buildings, public	5,961	34,179	57,983	78,700	103,331	144,403	**424,557**	**735,854**	409,255	2,250
Unclassified, public	4,722	21,039	19,914	14,171	5,547	7,969	**73,362**	**169,807**	106,984	1,080
Total public	**11,731**	**61,691**	**116,772**	**101,791**	**118,630**	**154,924**	**565,539**	**1,143,198**	**696,219**	**6,469**
Federal government (included in above classifications)	10,009	53,436	105,721	96,528	110,801	149,692	**526,187**	**1,023,287**	468,819	....
Private										
Bridges, private	....	....	....	....	13	....	**13**	**105**	629	....
Buildings, industrial	1,056	6,285	100	22,012	1,956	1,700	**33,109**	**52,809**	149,410	2,220
Buildings, commercial	2,830	8,443	550	3,430	9,154	2,806	**27,213**	**53,555**	121,232	150
Unclassified, private	....	2,121	150	1,275	4,593	810	**8,949**	**13,936**	41,328	200
Total private	**3,886**	**16,849**	**800**	**26,717**	**15,716**	**5,316**	**69,284**	**120,405**	**312,599**	**2,570**
Total Engineering Construction:										
February, 1942 —(4 weeks)	**15,617**	**78,540**	**117,572**	**128,508**	**134,346**	**160,240**	**634,823**	....	....	**9,039**
January, 1942—(5 weeks)	24,274	140,757	229,508	88,743	78,558	66,940	**628,780**	....	....	7,856
February, 1941—(4 weeks)	25,943	105,747	80,121	85,142	72,341	54,975	**424,269**	....	....	8,391
Two Months—1942	39,891	219,297	347,080	217,251	212,904	227,180	....	**1,263,603**	....	16,893
Two Months—1941	58,280	235,680	215,121	210,250	151,242	138,245	....	....	1,008,818	15,945

HOW TO IMPROVE VISIBILITY of strategic highways and access roads



Finger-tip control of visibility with White Concrete Reflecting Curb

HEADLIGHTS "ON"—*a gleaming white guide to safety . . .*

HEADLIGHTS "OFF"—*a complete blackout*

● In daylight this concrete reflecting curb made with Atlas White Cement dominates the highway. On a rainy night (top) it is a brilliant white guide to safety along the blacked-out roadway. Reason: The scored finish reflects car headlight rays directly back to the driver's eyes and the white concrete curb stands out in sharp contrast to the surrounding blackness.

Today, more than ever before, it is essential to provide adequate visibility on strategic highways and access roads. It is equally important to reduce highway accidents. White Concrete Reflecting Curb helps both, even under minimum lighting conditions. It depends upon headlight rays—no other illumination is needed—to provide visibility.

Your rear-view mirror tells the secret. Only when placed at the *correct angle* does it reflect to you the car behind you—make it visible. So also with curb. If smooth, it reflects the driver's headlight rays in the wrong direction—at the wrong angle. The reflection is wasted. Visibility of the curb is poor. But when the curb has "saw-toothed" faces properly designed — correctly angled—to reflect the driver's headlights back to him, then the curb becomes highly visible.

With headlights "off," reflecting curb is completely blacked out. But a flick of the headlight switch and a continuous ribbon of light defines the highway for the driver, far ahead of the car.

THIRTY-TWO-PAGE BOOK, complete with photographs, illustrations, working drawings and specifications, tells the fascinating story of this new safety curb. Send today for a "A WHITE GUIDE TO SAFETY." Write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Bldg., New York City.

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ENR-M-28

WHITE CONCRETE REFLECTING CURB

MADE WITH ATLAS WHITE CEMENT

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • MARCH 12, 1942 • VOLUME 128 • NUMBER 11

Simplify procedure on major army engineering contracts

Consolidation of Quartermaster Corps divisions into one body eases contract negotiation machinery; command shakeup leaves construction untouched

Now that the Corps of Engineers has shifted the entire load of awarding contracts under $5,000,000 to the district and division offices, it has proved possible to simplify the machinery for contract negotiation in the Washington office. Two groups which were taken over from the former construction division of the Quartermaster Corps have been consolidated: the Construction Advisory Committee, which formerly had the job of compiling information about contracting and engineering firms and recommending three or more firms with whom to negotiate when a contract was to be awarded; and the Contract Negotiation Board, which carried on the negotiations with firms picked by the advisory committee.

The two bodies are now combined into a new Construction Contract Board, responsible for the full job of awarding contracts running over five millions. It is to be assumed, of course, that in many cases, perhaps most, even these larger contracts will already have been thoroughly thrashed out in the field, and board action will be something of a formality.

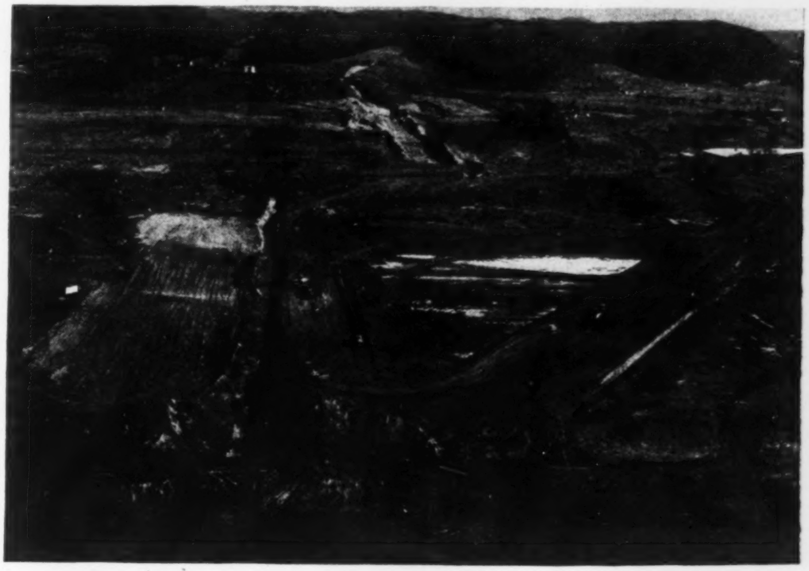
Of the five members of the new board, the chairman—Lt. Col. W. M. McKee—and H. W. Loving are former members of the Contract Negotiation Board. The other three are R. H. Tatlow, III, F. S. Harvey and A. J. Hammond, all formerly on the advisory committee.

The new board will take over the office and records of the former advisory committee, so that contractors and engineers whose records were on file with the committee need not file any additional data. Firms interested in large jobs are advised to see that their records are on file, preferably in identical form, with the Construction Contract Board and with the division and district engineers having jurisdiction over the firms' territories.

Meanwhile, major changes during the past weeks in war procurement policies have as yet had no important effect on construction procedures. Reorganization of the Army into three main units—air service, ground service, and service of supply—leaves Army construction concentrated as before in the Corps of Engineers. The Corps has been placed without any internal change in the Service of Supply, reporting to Gen. Brehan Somervell.

It is of course not impossible that in the future some changes will be made. Thus the combat units of the corps might be split off and placed under Gen. Leslie McNair in the ground service. But present construction procedures of the Corps follow in the main the systems which Somervell himself introduced.

The second big change—Donald Nelson's order eliminating competitive bidding from war buying—does not affect construction either. The order is aimed specifically at the buying of goods rather than at construction. Procedure in awarding construction jobs remains on a competitive bidding basis when time permits, and negotiation otherwise.



Work under way on earth fill for Wolf Creek Dam

Construction is proceeding rapidly on the $55,000,000 Wolf Creek Dam across the Cumberland River near Jamestown, Ky. The dam will have a maximum height of 242 ft. and a total length of 5,730 ft., of which 1,836 ft. will be of concrete and the remainder rolled earthfill. The picture above was taken from a 250-ft. high bluff that forms one abutment of the dam. Rock bluffs forming the other abutment are shown more than a mile away. A trench has been opened along the upstream toe of the earth dam and a temporary earth cofferdam is under construction at the right.

The concrete portion of the dam, across the main channel, will require 1,250,000 yd. of material for construction of the spillway, power house and adjacent non-overflow section. The earth embankment will have a maximum width of about 1,500 ft., will rise 190 ft. above the valley floor and will require 11,500,000 cu.yd.

Work is being done under the direction of the Nashville, Tenn. district Corps of Engineers, U. S. Army. The general contract is held by the S. A. Healy Co. of Chicago.

Study reduction of types of construction material

The War Production Board now has underway studies designed to sharply reduce the number of types of many major construction materials and allied products. Particularly in line for early action is cement, manufacture of which will probably be restricted before long to five or perhaps three types. Reduction in types of reinforcing bars is also being considered, and WPB is working with the Engineers Defense Board—an unofficial group sponsored by the technical societies—on a manual of standards for economical steel design.

In the field of alloy steels, WPB consultations with the steel industry and the technical societies have resulted in a decision to gradually limit production of alloy steels to those specified in a set of National Emergency Steel Specifications. Effect of these specifications is to limit use of nickel, chromium, tungsten, cobalt, and vanadium as alloying elements, emphasizing instead manganese, molybdenum, and silico-manganese alloys.

The more normal procedure in simplifying materials will be however for WPB to issue orders giving compulsory force to simplification programs developed by the Bureau of Standards, programs similar to those which the bureau has been developing on a voluntary basis for the past twenty years.

The cement order now under consideration was developed similarly in consultation with the bureau and the A.S.T.M. It is intended to increase the capacity of present cement mills and thus avoid plant expansion, necessity for which has been appearing as imminent on the West Coast. As recommended by the Bureau of Standards, the order would limit types of cement to five—a normal Portland, a high early strength, a low heat, a moderate heat, and a sulphate resistant. These would conform to A.S.T.M. specification C-150.

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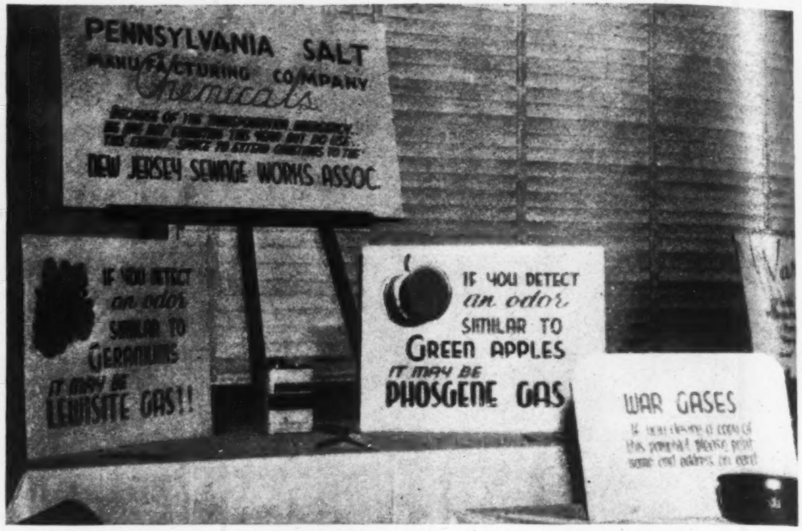

Trend of the times in convention exhibits

Evidence of the effect of war is this exhibit of the Pennsylvania Salt Mfg. Co. at the convention of the New Jersey Sewage Works Association last week. Because of the transportation emergency the company did not ship materials for display, but used the space to dramatize educational material on the subject of war gas detection and protection.

Illinois sets up defense water equipment corps

The Illinois State Division of Sanitary Engineering in cooperation with the State Defense Council, has completed a plan for the establishment of an emergency water corps which will list all equipment available for emergency use.

Under the plan, the state's 102 counties will be divided into ten zones. Each zone will be headed by a coordinator—a waterworks engineer located centrally in the zone—who will have the duty of listing emergency equipment available in his sector. In case of emergency the coordinator will direct the sending of equipment and supplies to any point where an emergency exists. He will also assist in the organization of a local corps, to be trained in plant and distribution system operation and repair work.

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Plant construction work split between two unions

Ending a jurisdictional controversy between representatives of American Federation of Labor and Congress of Industrial Organization Workers over the right to install machinery in an expanding factory, the National War Labor Board in a recent decision split the work between laborers affiliated with the two organizations.

The dispute arose at the Toledo, Ohio, plant of the Spicer Mfg. Corp., a principal source of transmission for light tanks and other combat vehicles. During construction of an addition to the plant, the question arose as to whether the company's own maintenance employees—represented by the CIO—should install the lighting, the wiring for power equipment and the machinery; or whether this should be done by AFL construction workers employed by a subcontractor.

William H. Davis, chairman, who acted as arbitrator for the board, ruled that the company's maintenance workers should install all of the approximately 1,200 old machines that are to be moved from other portions of the plant; and that AFL laborers should install lighting and power equipment and approximately 400 new machines purchased for the new addition.

Approve $3,028,208 FWA school building program

Marking the start of an accelerated war public works program, President Roosevelt recently approved 69 projects for the construction of schools in 19 states, according to the Federal Works Agency. The projects, approved as necessary to provide adequate educational facilities for the children of industrial war workers and members of the nation's armed forces, will cost a total estimated at $3,028,208.

Costs of the schools and school improvement work range from a low of $800, for facilities in Jefferson county, Colo., to a high of $172,000 for construction of a 31-classroom building at Lakewood, Calif.

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New commissioner named for New Jersey highways

Spencer Miller, Jr., professor of business administration at New York University, was named head of the New Jersey State Highway Department by Governor Edison on Mar. 9, to succeed E. Donald Sterner, whose resignation becomes effective on April 29. The appointment has yet to be confirmed by the state senate. Prof. Miller is a resident of South Orange, N. J., a son of Spencer Miller, retired chief engineer of the Lidgerwood Mfg. Co. In addition to his studies in business administration, Prof. Miller took post graduate work in engineering.

U. S.-Alaska Highway now under construction

Road now under construction by U.S. Engineer troops is temporary route. Permanent highway to follow

U. S. Engineer troops are engaged in the first part of a two-stage highway program connecting the continental United States with Alaska. One party is working north from Fort St. John, British Columbia, and another is starting in both directions from Whitehorse, Yukon Territory. They are building a "pioneer" road—a narrow, unsurfaced highway designed with the sole object of creating a passable thoroughfare as quickly as possible.

Subsequently it is intended that the Public Roads Administration will build a permanent, all-weather road of normal width along the same general route. Existence of the pioneer road will greatly facilitate this job. Before the permanent road can be built, however, Congress must authorize the project and appropriate some $25,000,000. It is expected that the President will request such action.

Route chosen for the Alaska highway is somewhat to the east of those which have been discussed in the past.

This was decided upon for the double purpose of keeping 300 to 500 miles from the ocean and of connecting with a chain of existing airfields. The new road starts at Fort St. Johns, B. C., which is now connected by road and ferry with the railhead at Fort Dawson. Thence the road runs north toward Fort Nelson and Watson Lake, Yukon Territory. From there it continues along the Kluana River to Whitehorse, Y. T. This town, at which work is starting simultaneously, is the railhead of a line from the coast. From Whitehorse, the road will run to Boundary, Alaska, and along the Tanana River to Big Delta, which is already connected by road with Fairbanks.

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Highway board to advise British Columbia on roads

A highway board staffed by senior engineers has been appointed to advise the British Columbia Ministry of Public Works on how best to use its limited funds for highway construction and maintenance.

R. W. Bruhn, Minister of Public Works, explained that the new board will act as an advisory council and will have as one of its chief functions the gathering of data on public works affairs for the use of the department. Other duties will include recommendations for standardization of work done by the Bureau. Board expenses will be taken care of entirely within the present budget.

W. C. Markham to retire

W. C. Markham, executive secretary of the American Association of State Highway Officials since its organization 21 years ago, has Handed his resignation to the directors of the association to become effective when a successor can be obtained. Mr. Markham started his career as a newspaper man in Kansas and still owns a semi-weekly newspaper in California. In 1917 he became the first highway commissioner of Kansas, a job he held until he joined ASSHO.

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Wm. L. Abbott receives Washington Award

The Washington Award, coveted honor of the engineering fraternity, was presented Feb. 26 in Chicago to William L. Abbott (left), retired chief operating engineer of the Commonwealth Edison Co. and former president of the board of trustees of the University of Illinois. A bronze plaque inscribed: "For advancing the standards of the engineering profession; for service to higher education; for aiding combustion research," was presented by F. H. Lane (right), president of the Western Society of Engineers.

Substitutes permitted in Portland buildings

Anticipating wartime demands which may make certain products now considered standard in building construction work difficult or impossible to obtain, the city of Portland, Ore., recently passed an ordinance which will permit the use of substitutes in construction of new buildings or repair of old ones.

William A. Bowes, commissioner of public works, said that in the near future action will be taken to approve the use of wooden gutters and down spouts for frame buildings, in place of metallic gutters, and the use of asbestos board for exterior furnace casings and for air duct lining, in place of metal. Before approving the use of any particular substitute, Mr. Bowes said that an investigation will be made to determine, first, that materials called for by existing codes are not available, and second, to determine the suitability of the proposed substitute.

Commenting on the change, Commissioner Bowes stated that the general policy of the city is that changes in the building and other codes, due to war emergency conditions, are not desirable, because such changes may become permanent. "It has been considered that the situation could be taken care of best by allowing substitutes under the conditions set forth in the ordinance," he added.

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Contract awarded for removing elevated road

The trustees of the Boston Elevated Railway have authorized the Associated Metals & Minerals Corporation, New York City, to remove the Atlantic Avenue structure of that property. The contractors will pay the railway $49,100 for the privilege of removing the structure. It is estimated that the job will require from three to four months.

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Steel shortage halts Toronto sewage plans

Toronto, Canada, city officials have received notification that reinforcing steel required for the construction of a new sewage treatment plant is not now available, and have abandoned plans for construction of the plant probably until after the war.

The $3,000,000 plant would have required about 1,950 tons of reinforcing steel. City officials said they had made arrangements to obtain the steel from a Canadian firm, but had been advised by M. A. Hoey, deputy steel controller, at Ottawa, that this metal is not available at this time.

New Jersey sewage group affiliates with Federation

Unanimous adoption of a new constitution by the New Jersey Sewage Works Association on March 6 paved the way for affiliation of this group with the Federation of Sewage Works Associations. Thus at its 27th annual meeting, the oldest American sewage works group liquidated prejudices and misunderstandings that have kept it from being part of an international body organized more than a year ago.

When the constitution of the association is formally approved by the Federation late this spring, the New Jersey group will be the 27th organization in this country and abroad represented on the Federation's board of control. The New Jersey association heretofore had rejected affiliation partly because it feared loss of autonomy in conducting its local affairs.

The two-day meeting, which featured a technical program on plant operation problems, included an equipment exhibit by some 20 manufacturers.

Funds for plant operation

Prof. Clarence J. Velz, head of the civil engineering department at Manhattan College, outlined a method whereby sewage works might be assisted in getting adequate funds for operation. He proposed that regulatory bodies, such as state health departments, extend their service functions to furnish advice on technical matters. In fact, it might be advisable to clothe state health departments with such legal powers as would permit them to demand the inclusion of proper operating funds in municipal budgets, said Prof. Velz.

Elected president for the coming year to succeed Sam R. Probasco was Henry Van Der Vleit, superintendent of sewers, Maywood, N. J. John R. Downes, supervising engineer, Plainfield, and Paul Molitor, Jr., plant operator, Morristown, were reelected as treasurer and secretary, respectively.

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Kansas will use radio to direct road work

The Kansas State Highway Commission has been notified by the Federal Communication Commission of approval of licenses for two fixed radio transmitters to be used for highway maintenance and patrol communication. Use of the transmitters will make one-way communication possible between the highway department and its maintenance trucks and cars.

A 500 watt transmitter at Topeka will be supplemented by a 150 watt unit.

Transmitters will be operated on a 24-hour basis by NYA assignees.

Road builders annual meeting centers on war restrictions

American Road Builders Association devotes major part of its annual meeting to learning how to carry forward essential work under restrictions growing out of the war.

Chief interest in the annual meeting of the American Road Builders Association at Memphis, March 2-5, centered on the effect of war restrictions on the highway industry. That these restrictions would cut drastically into roadbuilding operations was accepted as inevitable without complaint; the major concern, however, was the possibility that lack of knowledge of how the restrictions are to be applied would keep the highway builders from contributing most effectively to the war effort. This spirit found expression in a resolution, adopted by the directors at the close of the meeting, pledging the association to do its utmost to aid the President and the armed forces to win the war decisively and quickly.

Prior to adoption of this resolution the board gave concrete expression to the thought back of the resolution in turning down a proposal put forward by the public relations division to launch a program to educate the public as to the importance of good roads in the national economy. It was felt that nothing should be undertaken at this time that would detract from the war effort. The board also went on record as reaffirming its stand in favor of the contract system of road construction.

The importance of efficient functioning of highway transport during the present emergency was stressed by Hal G. Sours, president of the A.R.B.A. in opening the convention. Maintenance and reconstruction of all highways of military importance must be speeded, he said, and he added that where highways not on the strategic network have become of importance to the war effort because they serve essential industries, the states will have to keep those roads in efficient condition without federal aid. The importance of these roads to the nation's war effort has not been fully recognized in Washington, he said, and until that is recognized the states will have to carry the load despite the fact that the federal government should share in the cost.

Mr. Sours urged the federal authorities to speed the approval of work on essential highways and to advise the states of the extent to which the federal gov-

Skyway Photo

Old and new presidents of A.R.B.A.

Hal G. Sours, director, Ohio Department of Highways, president of the American Road Builders Association for the past two years (left), introducing the new president Chris J. Sherlock, until recently, director, Alabama Highway Department. Mr. Sherlock has resigned as state highway director to run for governor of the state.

ernment will participate in the task of maintaining the efficiency of roads essential to the war effort, so that the states can make the most of available funds.

Modifications in standards

Design standards must be modified for the emergency, Mr. Sours said, in order to make each dollar go as far as possible while conserving critical materials. Rationing of tires and fuel will result in a reduction of average speeds and in the use of passenger cars, hence designs that are based on meeting the demands of high-speed travel can be modified. Thus, where a road needing resurfacing normally would be widened in the resurfacing, it will not be widened under the emergency program. This will release material to extend the amount of surfacing that can be done with available funds. Similarly, where, under normal circumstances, reconstruction of a main road calls for adding lanes, no lanes will be added now.

In planning for construction and reconstruction during the emergency Mr. Sours recommended to highway departments that they modify their contracts, especially with respect to change orders, to facilitate substitution of materials without wasteful delays when that is necessary.

Federal-aid policy

Both at the opening session and at the "Victory Banquet" Mr. Sours laid special stress on the importance of maintaining the present federal-aid system of highway building, pointing to the many benefits that have grown out of the nationwide planning of highway development that was set up following passage of the first federal-aid highway act. He noted that normal federal contributions would be drastically cut during the war but said that this should not be made a justification for dropping the system. In a like vein, at the dinner, he urged the men who have participated in A.R.B.A. activities and who have contributed to its support not to let the war divert their interest in maintaining the effectiveness of that organization. A.R.B.A. is needed now, he said, to help the highway industry to make the greatest possible contribution to the war effort and it will be of great value in the post-war period.

War production loads

Details of the load that war production is putting on the highways of Michigan were given by G. Donald Kennedy, highway commissioner of that state and president of the American Association of State Highway Officials, in his plea to highway men at the meeting to do all they can to help convince civil and military authorities in Washington that our highway system is not adequate for the load that war production is going to put on it. Highways for the movement of materials and employees are not as spectacular as highways for the movement of troops, but they are more important right now to our war effort, Mr. Kennedy said.

Turning to the problem of maintenance during the war period, Mr. Kennedy suggested merging highway and airport maintenance to conserve equipment and to make the most of the skill of trained highway maintenance men.

Roads and transport

A strategic network is something more than a system of roads over which troops move, it is a system of roads that serves the arsenals that equip those troops, said Willard Chevalier, past-president of the A.R.B.A., in urging that our highways be not permitted to get into a condition that will chew up the rubber and damage the motor vehicles that we are trying to conserve. Bad-order roads mean bad-order transport.

Chevalier offered a three-point program: (1) Determine as swiftly as possible what roads are essential to troop movements and what to the service of war industries and basic civil needs; (2) prompt action to assure the maintenance of these roads; and (3) develop coordination of state and federal highway agencies in making the most of available men, materials and equipment. Money has lost its significance, he said, it is only time that counts now.

Wilburn Cartwright, chairman of the House Roads Committee, stated that only such work will be done on the strategic network as will meet immediate war needs, that even some of the work that the Army would like to have carried out must be deferred or reduced. Maintenance of those roads that are essential to the war effort will be of major importance, and that work must get priorities both for equipment and materials.

What happens to the highway industry, Congressman Cartwright added, will be dictated solely by war needs.

Military roads

Col. John W. Wheeler, commanding officer of the 113th Engineers at Camp Shelby, Miss., reported that one of the chief lessons of the 1941 maneuvers in Louisiana and Texas was that we lack knowledge of how best to coordinate the movements of motorized highway transport. As to the road itself, a major need is shoulders 12 ft. wide. Regardless of pavement width, all highways should have 12 ft. shoulders wherever topography will permit. Military convoys cannot be moved satisfactorily without wide shoulders which permit one unit to stop clear of the roadway without blocking the movement of other units or essential civil traffic. Provision of points where military convoys can leave the highways to seek shelter among trees would be a valuable aid during maneuvers, Col. Wheeler said.

As to narrow and weak bridges, Col. Wheeler said that they present a problem with which the engineers of the army have to contend as each is met. Weak bridges can be strengthened, and if their width proves to be a bottleneck temporary bridges will have to be provided.

At a later session, in answer to questions with respect to wheel loads produced by military equipment, Col. Wheeler said that military loads that can be expected to move for any distance over our highways compare favorably with commercial loads. The heaviest unit now mounted on wheels is the 155-mm. howitzer. Its gun weighs 4½ tons and the prime-mover, when loaded, weighs 11½ tons. The 155-mm. rifles are tractor-mounted. They will be moved by rail as far as possible. A large truck-drawn howitzer now under test will have a prime-mover weighing about 15 tons.

Tanks and other heavy equipment will be run over roads only in the theatre of operations. Long road movements are not contemplated, due chiefly to the low life expectancy of the tires and tractors.

As to the effect of military maneuvers on road surfaces, Col. Wheeler said that

W. W. Polk named Illinois highway chief

Wesley W. Polk, former commissioner of public works at Evanston, Ill., was named chief engineer of the Illinois Division of Highways on Feb. 28 by Gov. Dwight H. Green. He succeeds Ernst Lieberman, who resigned the position last Oct. 1. M. J. Fleming, assistant chief highway engineer, has been acting as chief since that time. Mr. Polk is a director of the American Public Works Association, and was connected with the city of Evanston for many years, first as superintendent of waterworks, later as commissioner of public works.

all main highways and the better built secondary highways are adequate, generally, for such maneuvers. Gravel roads with a light surface treatment will fail under successive loading by military vehicles. Speeds of the leading vehicles are set at 30 mph., but because of delays, following vehicles may have to run up to 40 mph. The army is opposed to sustained high speeds except in emergencies.

"Information Please"

The Tuesday morning session was given over to an "Information Please" type of program at which five engineers from various government departments undertook to answer some of the more important questions with respect to roads which have been raised by the nation's rapidly changing war regulations. Representing the Public Roads Administration were Lawrence S. Tuttle, senior highway engineer, and C. N. Connor, senior highway design engineer. Col. John W. Wheeler represented the Army; Perry A. Fellows, chief engineer of the Work Projects Administration, spoke for that agency, and A. D. Morrell represented the Public Work Reserve. Charles I. Stanton, acting administrator of the Civil Aeronautics Authority, was not present but had sent telegraphic answers to questions that had been submitted to him in advance. Willard Chevalier, presided at the sessions.

Approved types of projects

In answer to a question as to road projects approved by the PRA, Mr. Connor laid special stress on the fact that the PRA is not giving final approval to any project not certified to it by the Army or Navy. These still are limited chiefly to access roads to military establishments, to war industries and sources of raw materials, also to critical roads having substandard bridges or surfaces. Such projects need not necessarily be on the federal-aid system. Only a few have been approved to date. Subsequently, Mr. Tuttle amplified Mr. Connor's statement concerning approval of projects by saying that under the present order limiting road work, public safety is one basis on which a project can get approval, but there must be a real showing that public safety will be materially advanced. No big project, however, can get approval on this ground; approval is limited to such things as the installation of signals at a dangerous crossing.

Mr. Tuttle said he knew no rule to prevent the construction of road projects that require the use of no critical materials, but he noted that all projects do involve the use of equipment and labor, either of which may be scarce. Road projects that are badly needed could be done with used equipment, Mr. Connor said, but he recommended postponing all noncritical projects to conserve construction equipment.

Municipal road work

There is no bar against municipalities going directly to the PRA with applications for approval of projects that they believe should be carried forward under the present limitations, but as the PRA wants the advice of the state highway departments on all work within any one state, faster action will be obtained by working through the highway department.

Difficulties experienced by Allegheny County (Pa.) in getting approval of plans to reconstruct a weak bridge serving essential industries in the Pittsburgh district were cited by John F. Laboon. County authorities have tried since last July to get the project approved but can get nowhere because they always end up in being told that the industries the bridge serves have not been certified as essential industries, although all are engaged in war work. To this Mr. Tuttle replied that the difficulty might be due in part to the fact that a large amount of steel is involved. He suggested that Mr. Laboon try again, starting with the PRA.

Pavements without reinforcing

Asked as to the PRA policy with respect to omitting steel from concrete pavement, Mr. Connor said that in view of the scarcity of steel the PRA had approved omission of reinforcing and of load-transfer devices at all transverse joints, also the tie bars across longitudinal joints in slabs of suitable uniform thickness or in slabs with thickened edges along the longitudinal center joint when on a uniform subgrade.

With respect to spacing of transverse joints in slabs without load-transfer devices, Mr. Connor said that the PRA believes that expansion joint spacing should not exceed 120 ft. and that planes of weakness or contraction joints should be spaced not greater than 20 ft. He added that PRA is cognizant of the interest of states in increasing the length of slab between expansion joints or in the elimination of such joints, but said that it seems preferable to await developments from studies now under way in some states before modifying the present joint-spacing policy. PRA has no objection to omission of load-transfer devices at planes of weakness in slabs of 7 or 8 in. uniform thickness. Such devices also may be omitted at expansion joints in slabs of uniform thickness and tie bars may be omitted across longitudinal joints if desired but their use is preferred as they serve a useful purpose in keeping the slabs in line.

In reply to a question from Robert B. Brooks, member of the Missouri Highway Commission, as to how much concrete must be added when steel is eliminated from a slab, Mr. Connor said that depends on the adequacy of the subgrade, but that generally a slab of 7-in. uniform thickness could be substituted for a 9-6-9-in. slab, and an 8-in. thickness for a 9-7-9-in. slab.

WPA on maintenance

The WPA has given much thought to proposals that it takes up highway maintenance work, said Mr. Fellows, but the WPA does not want to get into the position of doing the day-to-day work for a local agency. Introduction of WPA into normal highway maintenance which must go forward currently, he observed, would simply mean the replacement of normal workers by WPA workers. Such efforts to cut the cost of maintenance to the local agency should be resisted, Mr. Fellows said.

WPA has no access road work of its own; it must have sponsors for such projects, just as for other work. Its labor and material restrictions, however, can be modified for war projects. It does not have to get such projects certified individually; its projects are certified through blanket certification of certain categories. Mr. Fellows also added a word of caution against putting doubtful projects forward as WPA projects in the hope of getting certification for them by that route. It can't be done.

Airport program outlined

C. I. Stanton, acting administrator of the CAA., in a telegraphed reply to questions submitted to him, stated that the CAA program for 1942 includes $88,000,000 in airport work, to be let by contract and an additional $10,000,000 for use on WPA projects. Advance notice of contract lettings will be available through local CAA offices or the district offices of the U. S. Engineer Department. This work does not yet have a high priority rating but higher ratings may be granted if difficulties arise in getting bids. Building work at airports is to be kept at a minimum.

Priorities clinic

Tuesday afternoon was given over to the War Production Board for priority clinics in which Memphis business men joined. These WPB sessions began with a luncheon meeting at which Harvey A. Anderson, chief of the conservation and substitution board of the WPB reviewed the causes for shortages in critical materials and outlined plans for their conservation. After lunch the meeting broke up into groups at which men from the WPB headquarters in Washington answered questions under eight different classifications, several of which were of interest to the construction industry.

In the maintenance and repair clinic it was brought out that after the truck limitation order goes into effect on March 9 applications for trucks can be made through local offices to be set up by the Office of Defense Transportation. Preference classifications have been set up, the first being trucks for military services, health, fire protection, police and utilities such as water supply, garbage collection and communications. The manufacture of trucks is to be continued but at a greatly reduced rate.

Additional information on this subject was given at the annual dinner by John L. Rogers, director of motor transportation of the ODT. Mr. Rodgers said that about 200,000 trucks will be available to meet the nation's essential needs during the next two years. He urged all having to do with truck transportation to do everything in their power to eliminate unnecessary road mileage.

The freezing order on track-laying tractors issued Feb. 19 was designed chiefly to permit available stocks of such tractors to be inventoried. It does not apply to maintenance parts.

Current highway problems

A scheduled talk on current highway problems by Thomas H. MacDonald, head of the Public Roads Administration, had to be cancelled due to Mr. MacDonald's inability to come to the meeting.

A picture of what army engineers are doing in the construction of camp roads was given by Col. Thomas F. Farrell of the construction division of the Corps of Engineers. The average cantonment for 30,000 men requires 18 miles of primary roads, 7 miles of secondary roads and 3 miles of low-grade construction. Local state highway specifications are used generally and local materials. Parking areas make up a large part of the road work as a normal camp requires 200,000 sq.yd.

About half of the defense construction already allocated to the Corps of Engineers has been completed; more is yet to come. The cost-plus-fixed-fee contract is now out for most army construction, lump-sum bids being substituted. Under the Architect-Engineer-Manager plan recently inaugurated contracts for most of the work will be let piecemeal; work that cannot be handled efficiently by contract will be carried out by the A-E-M.

Both Canada and Mexico were represented at the meeting. R. M. Smith, deputy minister, Ontario Department of Highways, reported that capital expenditures on highways in Canada are practically at a standstill. The only new work is on the last remaining link in the Trans-Canada Highway and on two major connections to the U. S. border. In the western provinces it is now fully expected that the long discussed highway to give the United States an overland route to Alaska will be built.

Representing Mexico were Carlos Bazan, director-general of highways; Luis Cuevas, chief engineer of design, department of highways; Jose Rivera, secretary of the Mexican Automobile Association and J. Lorenzo Sepulveda, executive vice president, Equipos Mechanicos. Both Mr. Rivera and Mr. Sepulveda told of plans now taking form in Mexico to set up an organization similar to the A.R.B.A.

Mr. Bazan stated that Mexico plans to spend 17,000,000 pesos this year on road work to aid in the defense of the Americas. This is three times as large as the highway building budget of any previous year. Included will be additional work on the Pan-American Highway, bringing three-quarters of that route through Mexico to completion, and a large amount of work on other highways of strategic value, such as roads reaching to the Pacific Coast. Due to differences in labor and material costs, Mr. Bazan said that these expenditures would produce as much as would the expenditure of the same number of dollars in this country.

Additional information on the part Mexico and the countries of South and Central America are playing in providing defense facilities was given by John Abbink, publisher of *Engineering News-Record* and *Construction Methods*, who spoke only in very general terms because of the censorship.

New officers

Chris J. Sherlock, recent director of the Alabama Highway Department, was elected president of the association. New vice presidents are Paul B. Reinhold, president, Reinhold & Co., Pittsburgh; Charles W. Smith, president, Smith Engineering & Construction Co., Pensacola; Lion Gardiner, vice president, Jaeger Machine Co., Columbus; and Robert A. Allen, state highway engineer, Nevada. H. C. Whitehurst, director of highways in the District of Columbia, was elected treasurer. New directors are Victor J. Brown, publisher, *Roads & Streets*; T. H. Cutler, chief engineer, Kentucky Department of Highways; Otto S. Hess, engineer-manager, Kent County Road Commission, Michigan; T. R. Kendall, editor, *Contractors & Engineers Monthly*; W. A. Van Duzer, director of vehicles and traffic, District of Columbia; Carl O. Wold, vice president, Caterpillar Tractor Co., Peoria; and W. A. Young, Cornell Young Co., Macon, Ga.

Skyway Photo

Experts answer questions at meeting of the American Road Builders Association

A major feature of the annual meeting of the American Road Builders Association at Memphis was an "Information Please" session at which experts from government agencies connected with roadbuilding answered questions raised by the nation's war plans. Left to right at the table are: C. N. Connor, senior highway design engineer, Public Roads Administration; A. D. Morrell, national director, Public Work Reserve; Perry A. Fellows, chief engineer, Work Projects Administration, Lawrence S. Tuttle, senior highway engineer, P. R. A., and Col. John W. Wheeler, 113th Engineers, Camp Shelby, Miss. Willard Chevalier, publisher of BUSINESS WEEK, presided.

OBITUARY

Grant R. Smith, 46, who had served as Shawnee County, Kan. surveyor for the past seven years, died Feb. 26 at Albuquerque, N. M.

William C. Gray, 90, retired engineer who supervised elevation of the New York Central's Rochester trackage in 1882, died Feb. 25 at his home in Rochester, N. Y.

David Riley Cook, former highway contractor of Montgomery, Ala., died at his home on Feb. 26.

William C. Bevins, 85, civil engineer who was formerly superintendent of the Seymour Gas & Light Co., at Seymour, Ind., died there recently.

John Martin Holder, 81, a retired building contractor of Greater Kansas City, died Feb. 28 at the home of relatives in Kansas City, Kan.

Fred Walter Abbott, 69, civil engineer of Germantown, Pa., died March 1 at his home.

John C. Wrenshall, Jr., engineer of maintenance of way for the Reading Railroad for 35 years, died March 1 at his home in Chestnut Hill, Philadelphia, Pa. He was 73. Mr. Wrenshall, who retired five years ago, was a nephew of the late General Andrew A. Humphreys, chief of Army Engineers.

Henry Lawrence Hawkins, 76, civil engineer of Seattle, died at his home there March 2.

James Murdock, 76, retired building contractor of Seattle, died in that city March 3. He had been a member of the firm of Murdock & Eckman, and constructed many Seattle buildings.

Clarence Howard Blackall, 85, architect who designed many Boston buildings and was credited with erecting the first steel frame building in Boston, died at the home of a daughter at Concord, Mass., March 5.

Thomas White Lamb, architect who designed Madison Square Garden, the Pythian Temple and scores of theatres in several parts of the world, died recently in New York. He was 71.

CONTRACTS AND CAPITAL

ENGINEERING CONSTRUCTION volume for the week totals $133,267,000, an increase of 0.5 percent over the corresponding 1941 week, but 8 percent lower than the volume reported for last week.

Public construction tops the week last year by 8 percent, but is 2 percent below last week. Private work is 41 and 44 percent lower, respectively, than a year ago and a week ago.

The current week's construction brings the 1942 total to $1,542,271,000, a gain of 24 percent over the $1,245,406,000 reported for the eleven-week period in 1941. Private construction, $154,338,000, is 46½ percent under the volume for the period last year; but public work, $1,387,933,000, tops a year ago by 56 percent as a result of the 103 percent increase in federal construction.

In the classified construction groups, gains over the preceding week are reported in bridges, earthwork and drainage, and unclassified construction. Increases over the corresponding 1941 week are in bridges, commercial building and large-scale private housing, and public buildings.

New capital for construction purposes for the week totals $6,231,000, an increase of 18 percent over the volume for the 1941 week. The week's new financing is made up of $3,853,000 in state and municipal bond sales, and $2,378,000 in corporate security issues.

New construction capital for 1942, $1,382,371,000, is just double the $693,264,000 reported for the eleven-week period a year ago.

CONTRACTS

(Thousands of dollars)

	Week Ending Mar. 13 1941	Mar. 5 1942	Mar. 12 1942
Federal	$84,323	$112,869	$110,048
State & Municipal	27,620	10,766	11,052
Total public...	$111,943	$123,635	$121,100
Total private..	20,683	21,766	12,167
TOTALS	$132,626	$145,401	$133,267

Cumulative
1942........(11 weeks)....$1,542,271
1941........(11 weeks)....$1,245,406

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1941 11 weeks	1942 11 weeks
NON-FEDERAL	$184,264	$140,416
Corp. Securities....	57,304	31,210
State & Mun......	87,539	95,377
U.S.H.A. loans	13,521	......
R.F.C. loans	25,900	13,829
FEDERAL	$509,000	$1,241,955
TOTAL CAPITAL....	$693,264	$1,382,371

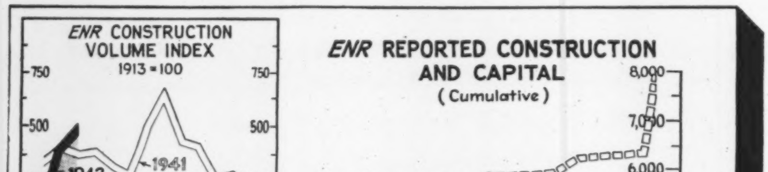
ENR INDEX NUMBERS

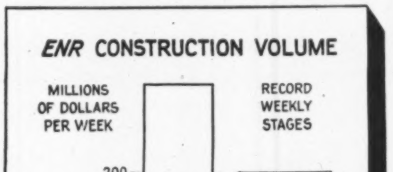
Index Base = 100		1913	1926
Construction Cost...	Mar. '42	269.71	129.65
Building Cost......	Mar. '42	218.88	118.32
Volume	Feb. '42	507	222

FHA MORTGAGES

	Mar. 8 1941	Week Ending Feb. 28 1942	Mar. 7 1942
Selected for appraisal			
Title II.....	$30,561	$14,488	$16,455*
Title VI.....	.....	$22,235	$21,271*

* Subject to revision.





Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Composite Bridge Deck Design

Sir: The article "Strengthening Our Highway Bridges" by E. L. Pavlo (*ENR*, Feb. 26, 1942, p. 339) is very timely and brings to the attention of the engineer the advantages of composite design. At the present time when conserving critical materials is of such importance, not enough attention is paid composite design, and we believe this is due to the lack of knowledge about it, which the article should tend to correct. However, we feel some credit should have been extended to our company which has spent considerable effort to introduce the particular type of composite design mentioned and holds the patents covering it.

C. P. Cueni
Porete Manufacturing Co.
North Arlington, N. J.

Rigid Frames Not Always Best

Sir:—Mr. Whittemore's suggestions for keeping small the amount of steel in reinforced concrete (*ENR*, Jan. 15, 1942, p. 115) are excellent. May I point out, however, that "making horizontal members continuous with vertical members (rigid frame)" while on many occasions highly desirable and expedient, on other occasions may not prove economical. The continuity creates bending stresses in the vertical members and imposes horizontal thrusts upon the foundations. The following case is illustrative.

Not long ago a certain western city had to replace the worn-out wooden approaches to an important bascule bridge and took alternate bids on steel and reinforced concrete on the higher part of the new work, 1,958 lin. ft. out of a total length 2,586 ft. The deck provided a four-lane roadway, sidewalks, etc., making the overall breadth 52 ft. 8 in. For the 1,650 lin. ft. of the competitive section, which was over water, average conditions were: roadway to water, 45 ft.; water surface to mud line and top of piles, 15 ft.; soft material, 15 ft.; additional pile penetration to refusal, 15 ft.

Under these conditions the writer recommended for the concrete design a series of continuous 150-ft. spans of hollow box type having a suspended section for expansion in every third span. Because of the length of the columns and the soft material surrounding the upper portions of the piles, it was proposed that whatever slight horizontal displacement might tend to develop be allowed to take place freely. The deck was balanced for dead loads and only live load and temperature effects were involved. There then would have been no horizontal reactions, no bending in the columns (of which there were three per bent, each 6 ft. square and hollow) and no rigid-frame action. The deck would have been a tame affair of continuous girders, and 80 vertical piles would have been required per bent.

The 150-ft. hollow box spans were retained by the city in the preparation of its design with suspended sections in alternate spans. Radical changes were made elsewhere. Rigid-frame action was decided on. The footings were enlarged and were provided with batter piles to prevent horizontal displacements. The piles were increased in number to 130 per bent. The three-column bent was replaced with a single pier, 39 ft. wide, hollow, tapering and widening from the footing upward. The bottom of this bent was jointed and socketed into its footing as a hinge, definitely preventing the development of bending moments at that point and as definitely making the pier unstable and in constant need of lateral support until the deck was poured. Thus horizontal thrusts were provided for, thus rigid-frame action was secured, thus on opening bids covering the whole job, which included a new deck on the bascule, the lowest bid on the concrete alternate was $696,000 and on the steel $670,000. The contract was awarded on the steel design, saving $26,000.

Not without further interest is the fact that the steel design was not a rigid frame, did not have columns hinged at their bases, employed girders continuous for four spans—100 ft. ends, 110 ft. interiors—used two separate columns, 14.5 ft. square per bent connected only at their tops, and utilized vertical piles only.

It is not amiss, before adopting rigid frames in all cases, to ask, "What price glory?"

Homer M. Hadley
Regional Structural Engineer,
Portland Cement Association,
Seattle, Wash.

Langer Tied-Arch Bridges

Sir: In the interesting article, "Tie Dominates Rib in St. Georges Arch" by Maurice N. Quade (*ENR*, Jan. 1, 1942, p. 22), it is stated that "Although there appears to be a European precedent, it is believed that the St. Georges Bridge introduces a new type of bridge structure to American practice."

There are, in fact, many such bridges in Europe where this type of bridge is generally known as the "Langer Truss" for the Austrian engineer who first used it. In the Italian journal *Annali dei Lavori Pubblici*, June 1937, p. 482, Dr. Ing. Fausto Masi describes a highway bridge over the Mallero (Italy) of 100-ft. span, all welded. Of the four types of design considered, Vierendeel trusses with parabolic chord, Pratt trusses with parabolic chord, parabolic tied arch and Langer trusses, the last was selected on the basis of economy and appearance.

Many bridges of this type have been constructed in Germany. Among the latest built, the Hütte's Handbook (*Manual del Ingeniero*, p. 966, Vol. III, 1940) names the Havel bridge in Potsdam; the railway bridge over the Weser in Höxter; the bridge over the Elder in Friedrichstadt; and the highway bridge over the Elba river in Tangermünde; the latter structure has a 377-ft. span.

The theory of the Langer truss is discussed on p. 274, Vol. II of the Italian translation *La Scienza dell Costruzioni* by H. F. Müller-Breslau, where there is an example for the main girders of the highway bridge over the Ihme, constructed in 1889 in Hannover, to designs by this celebrated late professor.

José Sanabria
Engineer, Chief Bridge Division
Department of Public Works
Caracas, Venezuela

EDITORIALS

VOLUME 128 NUMBER 11
March 12, 1942

War Transport Surveys Needed

THE APPEAL TO HIGHWAY ENGINEERS for aid in developing the pattern of transport required to serve war industries, made by Thomas H. MacDonald to highway officials of the North Atlantic States at Philadelphia (*ENR* Mar. 5, p. 368), calls for nation-wide attention. It is well known among highway authorities that the Washington Administration does not recognize the key position held by highways in the war effort. If our highways break down under the movement of materials to and from defense plants, or if their disintegration lowers the efficiency of our limited supply of motor transport, then the war effort will be seriously handicapped. Michigan recently made a survey of traffic generated by its war industries, and similar surveys are needed in every state to supply all of the basic facts. Only by tracing the national pattern of war transport on its proper scale can the President and the War Department be convinced of its significance to the war effort. Surveys of the character and intensity of the transportation of men and materials to war industries should get first priority in every state highway department.

Brakes on Progress

WIDE DISSEMINATION OF FACTS with respect to engineering failures and subsequent discussion of probable causes exert an important influence on engineering progress. There is general recognition of the truth of this statement, and there is much evidence in engineering history to attest to the wisdom that it expresses. Yet it is probable that more failures are hidden behind cloaks of secrecy than are properly publicized. Many reasons can, of course, be marshalled as to why this is so. Fear of legal action is the most frequent excuse, although it is greatly overrated, because if damaging facts exist lawyers will get them anyway. Another and more understandable reason for not talking about failures is pride. It takes courage to admit mistakes. Fortunately many engineers and contractors have had the necessary courage, and vision, too, to make information on failures public. To them the profession and the world at large owe a great deal. It is also pertinent to note that it is from failures of public works structures that we have learned the most, not because they are more numerous but because private interests—industrial, railway, utility and real estate, to name a few—have a greater tendency, and also opportunity, to keep details of their failures secret. But whether the failure occurs on a public or private structure, to limit its lessons to a few puts a distinct brake on progress. Not only engineers and contractors, but their employers as well, should ponder this fact. Too much lip service and not enough practical adherence is given to the adage that "we learn from failure."

Construction Safety

ACCIDENT REDUCTION, always a desirable objective on construction, becomes of paramount importance on the current war jobs. Education in the safe and proper way to work, constant encouragement in practicing safety, and, most important of all, a general plan of job safety that is known to every workman, are elements of a safety program on a powder plant job that has paid large dividends. As pointed out in an article in this issue, a basic reason for the success of this program has been the fact that the contractor sold his men the value of safety and, by constant reminders, kept them sold. Steady progress, because of fewer lost-time accidents, beat the scheduled completion date. Job safety is one way to avoid the charge of "too little and too late."

Full Return on New Ideas

THE MANY NEW SCHEMES developed to do work more quickly and with less or alternate material and equipment can be helpful to the war effort only to the extent that such schemes are known to others engaged in the same work. Most of the new ideas in use on construction are of far more value to our own war effort than they can be to the enemy because of differences in equipment available and in our methods of construction planning, and because of the time lag necessary to translate and disseminate information in another language. Censorship rules and regulations have been wisely drawn in recognition of the fact that all who develop new plans to speed vital jobs must share their best ideas if we are to win the war. The necessity for speed and the problems engendered by scarcity of some materials have placed a premium on the exchange of information. It is *Engineering News-*

Record's part in the war effort to effect this exchange in the quickly usable form made necessary by the curtailed reading schedule of today.

Ingenious and Promising

THE new architect-engineer-manager form of contract for Army construction, as worked out by M. J. Madigan, special constultant on construction matters to the Under Secretary of War, is an instrument of great promise. And this is said with complete recollection of the fact that it was criticized in these columns January 1, as a poor substitute for the type of negotiated contract that was used last year. Nor is praise now and criticism ten weeks ago inconsistent for, as finally worked out, the A-E-M contract does not contain the objectionable features of the early proposal. Furthermore, by assuring the participation of small contracting organizations in war construction, it offers a new and important advantage.

As it was generally understood, the first proposal required the architect-engineer team that designed a job to supervise the construction, which would be broken up into a number of small contracts, each let on competitive, fixed-price bids. That there would be enough architect-engineer combinations competent to run all the big construction jobs at maximum speed and efficiency seemed doubtful. Even assuming that inexperience in large-scale field operations might have been overcome by latent ability, the architect-engineer would have faced an impossible task in attempting to coordinate a group of contractors, each of whom had bid his part of the job with definite ideas of how it would have to be scheduled if he were to avoid a loss. Here were two difficulties that promised to slow down instead of speed up construction. And speed is what we are after.

As finally worked out, a contractor or "manager" was added to the architect-engineer team, thus supplying the necessary talent for directing field operations. This A-E-M combination is given a negotiated cost-plus-fee contract by the Corps of Engineers for the design and for that part of the construction that cannot be pinned down to a firm price, probably about 50 percent of the total. The remainder of the field work is divided into small firm-price contracts, let direct either on a competitive or negotiated basis by the Corps of Engineers, but with the requirement that the contractor work under the direction of the A-E-M firm.

Under such a set-up none of the advantages of a negotiated contract, as it relates to starting a job before plans are complete or to making changes or additions after it is underway, is lost. In addition, the talents of many small specialist firms can be brought to bear on the war effort. And finally, there is complete coordination of design and field work from start to finish. It is an ingenious plan and a constructive one. It must be made to work by all parties concerned, for there is no time now for further experimentation.

Our Burma Roads

ANNOUNCEMENT THAT CONSTRUCTION WORK has already begun on the much-discussed U.S.-Alaska highway comes as good news to amateur military strategists, who have long been puzzled by the War Department's lukewarm attitude toward the project. With the great sea highways of the world subject to destructive submarine blockade, "backdoor" land access to vital military points becomes a paramount necessity. The Alaska Road will be one of these backdoor roads—a Burma Road, as it were. And although its probable use of minimum widths, relatively steep grades and second-class surfaces and pontoon bridges will not compare with the great Alaskan highway that many have envisioned, it will nevertheless serve our military needs.

As one ponders the necessity for such a route north, there arises the question of a similar road south to another outpost, the Panama Canal. Must not the slow tempo of construction on the Pan-American Highway be speeded up? Don't we need a Burma Road south as well as north?

And as one carries this consideration of supply routes farther and thinks what huge flotillas of submarines could do to our coastwise shipping from the Gulf to eastern seaboard ports, the need of internal Burma Roads in the United States itself becomes clear. We have a good many, but we may need more. It is not yet safe to conclude that roadbuilding is going to be drastically curtailed until the war is over.

ENGINEERING NEWS-RECORD

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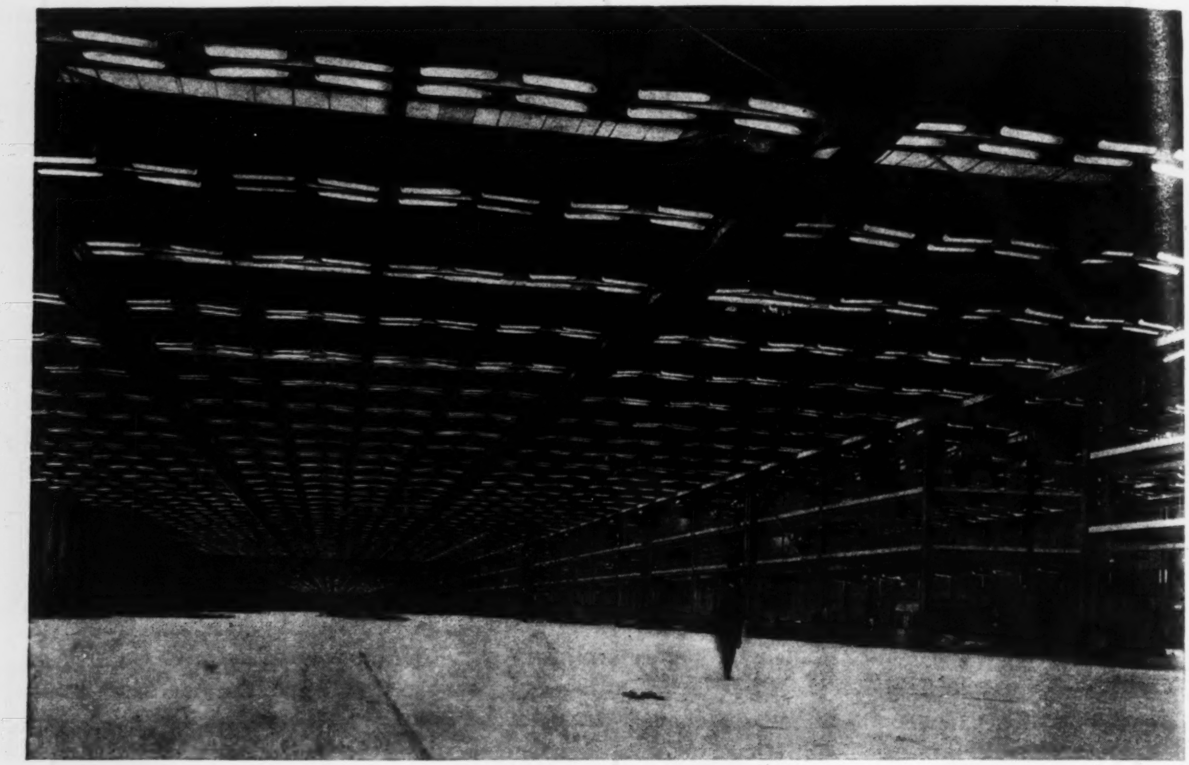
WALDO G. BOWMAN, *Editor.* E. J. CLEARY, *Managing Editor. New York:* V. T. BOUGHTON, J. I. BALLARD, A. N. CARTER, H. W. HUNT, E. R. DENMARK, *Chicago:* H. W. RICHARDSON. *Washington:* PAUL WOOTON, R. B. COLBORN. *San Francisco:* N. A. BOWERS, *Consulting Editors,* F. E. SCHMITT, W. W. DeBERARD

EDITORIAL OFFICES: 330 WEST FORTY-SECOND STREET, NEW YORK, N. Y.



Bomber plant assembly aisle where white cement floors will reflect overhead light into dark areas under the wings.

White Cement Floors for Better Light

Contents in Brief*—In the new bomber assembly plants a topping consisting of 1:2½ mix of white cement and white silica sand is being used on the floors to reflect light onto the underside of the wings and fuselages. Initial installations, using the white cement merely as a drying agent that was rubbed into the slab surface, were not particularly satisfactory. Placing of the mortar is followed by both machine troweling and hand troweling. Curing is aided by sodium-silicate spray coats protected by kraft paper and sand.*

AIRCRAFT ASSEMBLY LINES function most efficiently when the workers have plenty of light. For "topside" operations satisfactory illumination is available from windows, roof monitors or from artificial sources, but underneath a plane there are apt to be many dark areas. Particularly is this true of bombers whose huge wings and fuselages cast large and deep shadows. Portable spotlights are available and are used, but building designers, recognizing that increased general illumination was what was needed, first sought to get light into these dark areas by using light-reflecting paint on the walls. The most recent development extends this light-reflecting theory to the floors, but by surfacing them with white cement mortar instead of by painting. Unusually good results have been attained in several of the windowless bomber assembly plants built under the supervision of the Army Engineers, and it is on these jobs that an efficient technique for building such floors has been developed.

First, merely rubbed into surface

The idea of white cement floors was apparently originated by engineers of The Austin Co. about two years ago in connection with work for the Boeing Aircraft Co. in Seattle. There seems to be some difference of opinion as to whether the primary purpose there was light reflectivity or the desire for a light-colored surface to facilitate laying out designs and painting markings on the floor. In any event the proposal of a white cement mortar topping was rejected as too expensive and as a compromise white cement was merely used as a dryer that was rubbed into the slab surface before the concrete had set. Despite the fact that success was only mediocre, since the surface was just slightly lighter than that of a conventional slab, Boeing asked for a similar surface in its Wichita, Kan., plant, this time solely for light reflection. Results were somewhat better than at Seattle, but a change in manufacturing plans caused the area to be used for fabrication instead of assembly, and the floor became greasy and of no use as a light-reflecting medium.

White cement mortar is real answer

Opportunity for The Austin Co. to use its originally proposed white cement mortar topping came with the construction of the bomber assembly plants supervised by the Corps of Engineers. Because these were windowless structures with overhead fluorescent units as the sole source of illumination, maximum reflectivity was mandatory and worth the extra cost. It was obtained by covering the walls with white fiber glass sheets and the floors with white cement mortar.

Some 700,000 sq.ft. of floor in each of the several plants is topped with a $\frac{3}{8}$-in. surface of $1:2\frac{1}{2}$ mortar of white cement and white silica sand placed monolithic with the structural slab. A hardener was also added to the mixture.

The specifications fixed the proportions of aggregates to cement in the topping by stipulating that they should be the same as the proportions of fine aggregate to cement in the base course. Particular care was required to be exercised in selecting a sand that should be free from clay, silt or organic impurities that would cause discoloration of the mortar. Specified gradation of the sand was as follows:

	Percent by Weight
Passing $\frac{3}{8}$-in. Sieve	100
Passing No. 4 Sieve	95–100
Passing No. 16 Sieve	45–65
Passing No. 50 Sieve	5–15
Passing No. 100 Sieve	0–5

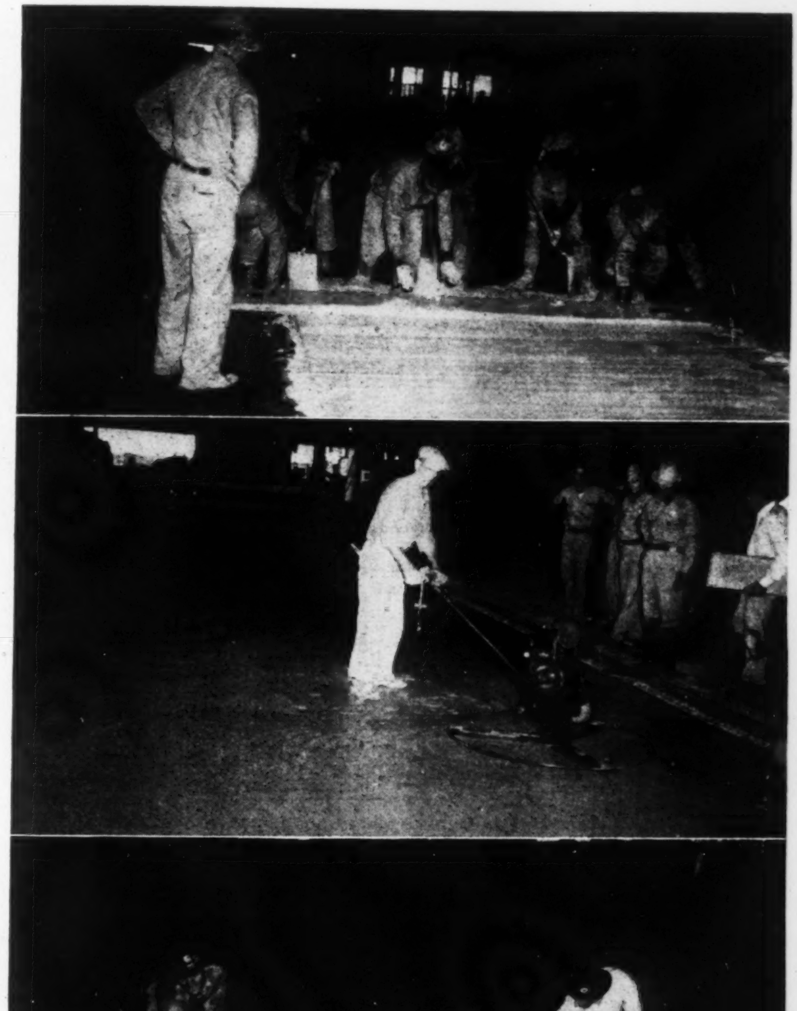
The specifications also required that separate mixing and placing equipment should be used for the top and base courses, and that mixing time for the white cement mortar should not be less than one minute. A plastic, workable mix was required.

How the topping was laid and cured

The accompanying illustrations show the several steps in placing, finishing and curing the white cement surface. Placing began before the base course had taken its final set, but after it had hardened sufficiently to permit walking on it without leaving appreciable heel marks; as complete a chemical bond as possible was desired between the gray cement base and the white cement top.

Deposited by wheelbarrows, the mortar was spread by hand shovels and struck off with a wood template pulled along pipe screeds whose tops were at finished floor level. Following initial set, the surface was given a preliminary finish with a gasoline-powered machine equipped with three rotating trowel blades. Final finish was by hand with celluloid trowels.

Immediately following the finishing operations, the surface was sprayed with two coats of a 1:4 sodium-silicate water solution that was low in calcium to prevent stain-



Successive operations in constructing the white cement topping. The first three views show screeding, machine troweling and hand troweling, while the bottom picture illustrates removal of kraft paper and sand after curing was complete.

Final operation before floor is placed in service is to wash and clean with a standard street sweeping unit equipped with special brushes, which is followed by a rotary polisher to impart as high a gloss as possible.

ing; the second coat was not applied until the first had completely dried.

Protection of the surface during the curing period was afforded by red weatherproof kraft paper placed about twelve hours after the mortar was laid and installed in strips 13½ ft. wide sealed at the laps with non-staining latex cement. After the paper was in place it was covered with a 1-in. layer of clean dry sand. The paper and sand were not removed until all construction that might damage the surface was completed.

After removal of the protective covering the floor was swept and then cleaned with full-size street sweepers equipped with special brushes. Final operation was polishing with special electric-powered rotary polishers.

Clogging Hazards in Underdrains

***Contents in Brief**—Inwash of earth is least when pipe joints are tight and the water enters the pipe through porous or perforated walls. Open joints are charged with the major clogging hazard in various forms of underdrain pipe tested.*

FREEDOM FROM CLOGGING in pipe underdrains is greatest when the pipe is of porous concrete or of metal perforated on the underside. This finding was reached following a series of tests made at the U. S. Waterways Experiment Station at Vicksburg, Miss., on six types of pipe used in ten arrangements, as shown in the accompanying table. In all cases the pipe was buried in a selected filter material; all the pipe, until clogged, carried off the water rapidly.

Method of testing

The tests were made in a wood flume on standard commercial 6-in. drainpipe. The flume was 2 ft. wide, 4 ft. deep and 36 ft. long, divided by bulkheads into a forebay 1½ ft. long, a test section 29½ ft. long, and a tailbay 5 ft. long. A 30-ft. length of drain of the pipe being tested was set in the test section to a grade of 1 percent with the ends penetrating and caulked tightly into the bulkheads so that no flow from forebay to tailbay was possible except through the pipe. A 3-in. pipe admitted water to the forebay and a 2-in. pipe admitted water to the test section. A venturi meter was placed in the 3-in. feed pipe, and the tailbay was provided with a 90-deg. V-notch weir with hook gage to measure the flow and a hopper to catch any solid material washing out of the pipe. To determine the hydraulic properties of each drain tested, a piezometer was set in the bottom of the pipe 5 ft. from each end and connected to a manometer outside of the flume.

The types of drainpipe tested are indicated in the accompanying table and are further described in the following section on results of tests. As each line of drain was connected up it was buried to the top in a filter material soaked into place underneath and up the sides by water admitted to the test section of the flume. This filter material was a mixture of 70 percent concrete sand and 30 percent medium gravel. The design of this mixture is shown by the accompanying grain-size curve. The mixture was selected: (1) on the basis of permeameter tests indicating a material very satisfactory for holding a fine base material and (2) as a material most likely to be available in ordinary drainage operations. This filling of filter material to the top of the pipe was next drained out; water was turned through the pipe from forebay to tailbay and depths and discharges of steady flow were determined; from these figures, values of n were determined from Manning's formula. These values, in general, were in good agreement with previous determinations by other observers.

After the rate-of-flow test, the tailbay end of the drain was plugged; water was turned into the test section of the flume, and filter material was deposited through water until the flume was filled with filter material to depths of 12 in. and 15½ in. over the pipe at the high and the low ends respectively. The infiltration test was then started by running water into the test section until there was a head of 12 in. over the filter material. The plug was then removed and the water allowed to run down through the filter material into the drain and out into the tailbay. Since the 2-in. feed pipe could not maintain this head against the rapid runoff through the drain, a total loss of the 12-in. head followed in about 20 min. and this was made the length of the test run.

Results of tests

In general it was found that none of the pipe tested, except when it would become clogged with the inwash of filter material, would limit or materially affect the overall efficiency of the filter. Individual figures of the quantities of water draining into the various types of pipe were not obtained, but the general statement is made that for a 29½-ft. pipe the quantity ranged from 0.3 cfs. to 0.4 cfs.

Pounds of filter material per ft. of pipe washed into test drains of various types:

Pipe	Perforations or Slots			Filter material washed in pounds per foot of pipe
	Size (in.)	Number per foot	Location	
Porous concrete, bevel joints, sections 2 ft. long	..	..	..	0.01
Porous concrete, lap joints, sections 1 ft. long	..	..	..	0.03
Perforated corrugated metal pipe coated with tar, sections 10 ft. long, split collar couplings (perforations around ⅓ periphery)	⅜	40	Down	0.03
	⅜	40	Up	0.2
Perforated concrete pipe, unsealed bell and spigot joints, sections 2½ ft. long (perforations around ⅓ periphery)	⅜	24	Down	1.3
	⅜	24	Up	2.3
Perforated clay pipe, unsealed bell and spigot joints, sections 2 ft. long (perforations around entire periphery)	⅝	30	..	3.7
Plain concrete pipe, unsealed bell and spigot joints, sections 3 ft. long	..	..	..	7.5
Semicircular cradle invert clay pipe, ½ in. open slot on top, unsealed bell and spigot joint, sections 2 ft. long	½	..	Top	8.4
	½	..	Top	Test void

Note: The metal drainpipe was coated with tar which reduced the area of the perforations about 50 percent.

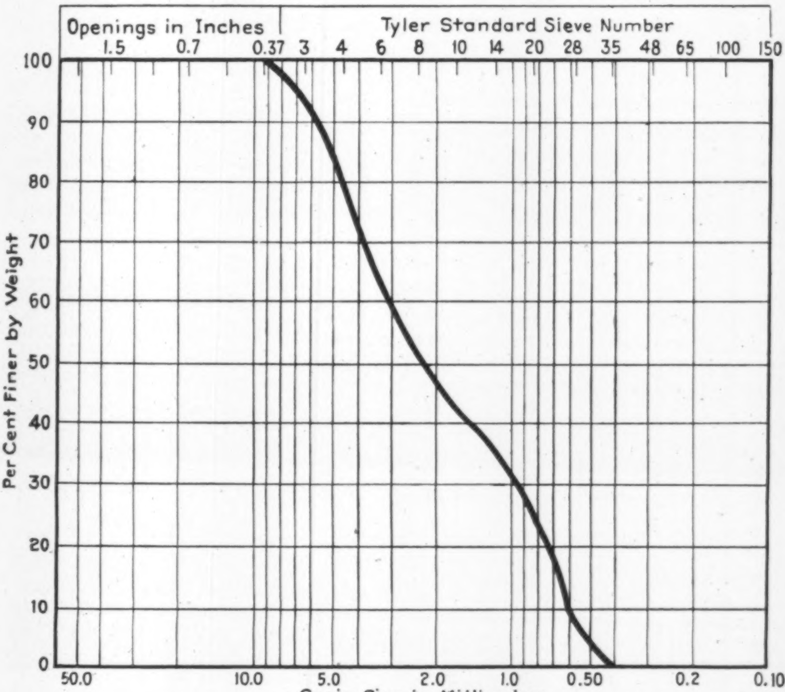
The amounts of filter material that washed into the various pipes, per ft. of length, during 20-min. are given in the accompanying table. As shown, the least inwash was (1) through the porous concrete pipe and (2) through the corrugated metal pipe perforated with ⅜-in. holes around one-third of its circumference and laid with the perforations down. The metal pipe sections were 10 ft. long with split collar (tight) connections. For one of the porous concrete drains the pipe sections were 1 ft. long with lap joints and for the other they were 2 ft. long with bevel joints; both forms of joints were quite tight. It will be noted that the metal pipe was most effective when laid with the perforated side down; because of a tar lining perforation in this pipe were quite small.

This was also true of the concrete pipe perforated on one side only but the inflow of filter material was much greater. This pipe was in 2½-ft. sections with bell and spigot joints left open, that is without being caulked or sealed with mortar. Since the perforations were not materially different from those in the metal pipe the greater amount of material collected is attributed to flow through the open joints. Open joints again appear to account for a large part of the solids collected by the perforated clay pipe. The pipe sections were 2½ ft. long with bell and spigot joints left open. The perforations extended entirely around the pipe and were somewhat larger (⅝ in.) than those in the concrete pipe.

Clogging in pipes

The greatest amounts of clogging were in the plain concrete pipe and the two types of semicircular clay pipes. The concrete pipe was in 3-ft. sections with bell and spigot joints left open. The semicircular pipe had 2-ft. sections with bell and spigot joints but of a special form. They had a gap around the semicircumference and a slot across the flat top. The tests indicated that a large part of the inwash was through the top slot.

The information given is from "Investigations of Filter Requirements for Underdrains," a technical paper published by the U. S. Waterways Experiments Station, Vicksburg, Miss. Besides the full-size drain tests the paper gives methods and results of a series of permeameter tests of filter material.



Fineness curve of filter used for imbedding pipe underdrains.

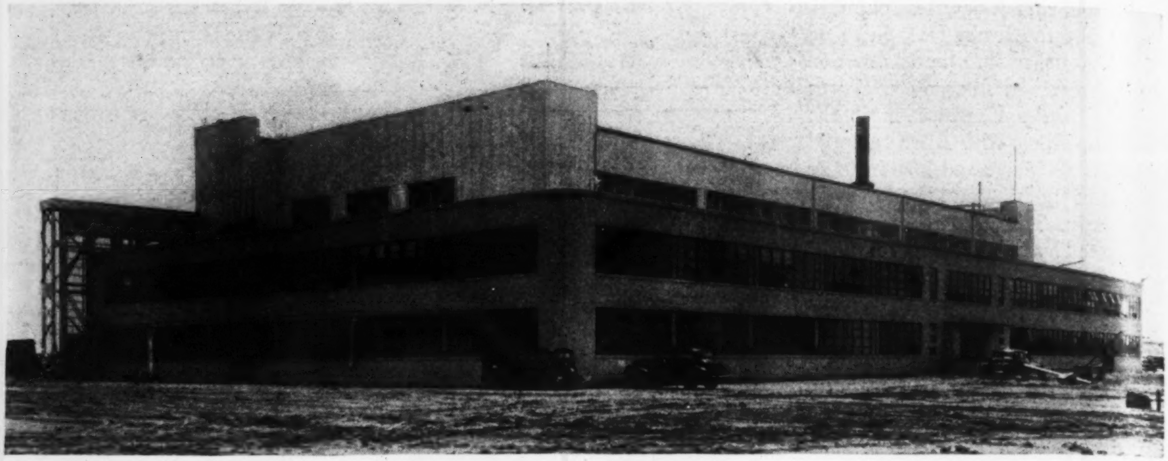


Fig. 1. Two-story portion of building is of reinforced concrete and provides space for offices and shops.

Combined Hangar and Office Building

***Contents in Brief**—For convenience, to reduce cost and to save materials, the offices, shops and hangar space for two airlines at the Denver airport have been combined in one structure. Here the use of both steel-frame and reinforced-concrete construction provided the most satisfactory type of building. An unusual feature is a heating system for removing ice and snow at the base of the large hangar door.*

RECENTLY COMPLETED at the municipally owned Denver, Colo. airport is a $300,000 combined hangar and office building that is to be leased by the city to United Air Lines and Continental Air Lines under a 25-year lease. In addition to providing both administrative offices and hangar space for airplanes, the building also makes available workshops and storerooms. For economy, two types of construction, reinforced concrete and steel frame, were used.

The offices and service rooms are located in an L-shaped, two-story, reinforced-concrete structure (Fig. 1), the first floor being used for repair shops, stock and accessory rooms, while all the offices are on the second floor. Under part of this structure a basement is provided, which contains the boiler room. No provision is made for passenger waiting rooms or ticket offices, as those facilities are already provided at the municipal airport building. The concrete structure is 25 ft. wide, with one portion 270 ft. long and the other 135 ft. long, and consists of regular column, beam and slab construction. The roof is also a concrete slab, while the outer sidewalls are of poured concrete construction.

Covering an area of about 107 by 220 ft., the hangar proper (Fig. 2) is of steel-frame construction laid out so that two sides of this space are embraced by the L-shaped office section. A 210-ft. wide by 35-ft. high unobstructed door opening enables the biggest transport planes to enter and leave the hangar. Independent door leaves, each about 35 ft. square, are provided for closing this opening, three leaves sliding to each side of the building. Special frames extending over the building line are used at each end of the doorway to receive the door leaves, and these frames are properly braced to take the wind load on the door leaves when in the open position. No siding was used on these frames, which resulted in economical construction.

Unusual heat unit below doors

An interesting new feature was introduced in connection with the sliding doors. Ordinarily these require heat trenches at floor level to thaw out snow and ice between door rails and wheels. On the Denver project

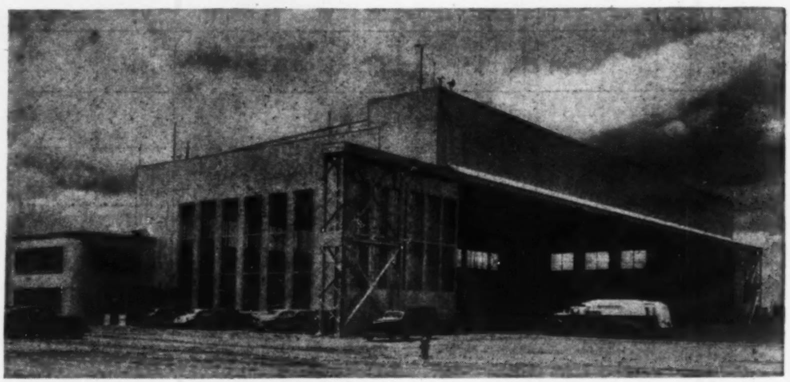


Fig. 2. Hangar section of building covers an area of about 107x220 ft. and is of steel-frame construction with sidewalls of asbestos-protected metal siding. Door opening is 210 ft. wide by 35 ft. high. Steel frame guards at each end protect 35-ft. square leaves of sliding doors.

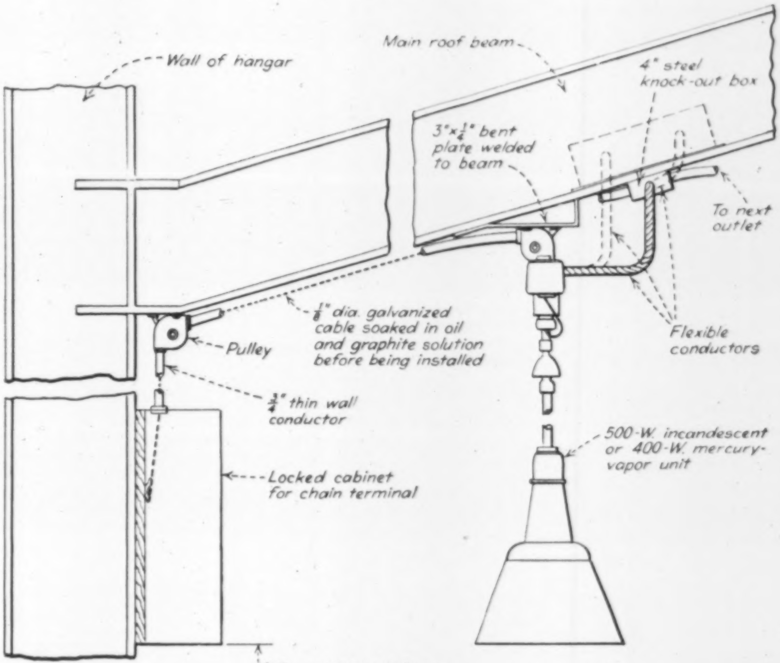

Wall of hangar
Main roof beam
4" steel knock-out box
3"×$\frac{1}{4}$" bent plate welded to beam
To next outlet
$\frac{1}{8}$" dia. galvanized cable soaked in oil and graphite solution before being installed
Pulley
Flexible conductors
$\frac{3}{4}$" thin wall conductor
500-W. incandescent or 400-W. mercury-vapor unit
Locked cabinet for chain terminal
5' from finished floor

Fig. 3. For maintenance lighting, fixtures of the hangar area may be lowered individually by cable and pulley arrangement.

these trenches were replaced with pipes that are to serve both as rails and as conduits for hot brine pumped from a tank in the boiler room. This innovation was designed and patented by the architect.

A 20-ft. deep steel truss of 211-ft. clear span is used over the door opening, and 107-ft. long steel transverse trusses spaced on $21\frac{3}{4}$-ft. centers frame into this member. The purlins run perpendicular to the transverse and parallel to the main truss in such a manner that the top chord of the longitudinal or main truss can be utilized as a purlin. A composition roofing on 2-in. thick wood plank is used over the hangar's roof framing.

For sidewalls of the hangar asbestos-protected metal siding is used. To emphasize the height of the hangar a comparatively narrow band of steel sash windows is used at a high level in the sidewalls, and this band is broken up with narrow widths of asbestos siding to give a balanced effect. Where the steel-frame structure borders on the reinforced-concrete building, the structure is of concrete column and beam construction with concrete block curtain walls. The steel columns above the wall, for the added height of the hangar, rest on the concrete columns.

Artificial lighting units for the offices, kitchens and repair shops in the two-story section are almost entirely fluorescent units of the direct or semi-direct type suspended from the ceiling. Lighting of the hangar area is by alternate units of high-bay 500-watt incandescent and 400-watt high intensity mercury-vapor fixtures mounted at truss height. The system was designed to produce approximately 20 to 25 footcandles at floor level. Each lighting fixture is supported by a hanger (Fig. 4) and can be lowered by means of a cable and pulley system for maintenance. The cables terminate in rings secured in locked boxes located advantageously around the walls.

Special receptacles are provided in the hangar floor, which is a 6-in. thick reinforced-concrete slab, for grounding the planes while they are being serviced. Each receptacle is connected to a rod driven 10 ft. into the ground and interconnected with all other ground rods and joined to the steel building columns. All receptacles, switches, panels and other electrical outlets in the sidewalls are located $4\frac{1}{2}$ ft. above the floor level to reduce the danger of an electric spark igniting explosive gasoline fumes near the floor. Likewise, each of the two special service pits in the hangar floor, which have outlets for water, air and electricity, are equipped with water and explosion-proof receptacles for 120-v., single-phase, and 208-v., 3-phase current. These outlets are made explosion proof by breaking the contact in a sealed chamber inside the receptacle.

The building was designed by Albert Kahn Associated Architects and Engineers, Inc., Detroit, with F. A. Fairbrother in charge of the job, and O. C. Foster as the architect's superintendent of construction. Contractor was Mead & Mount Construction Co. A. K. Vickery is city engineer.

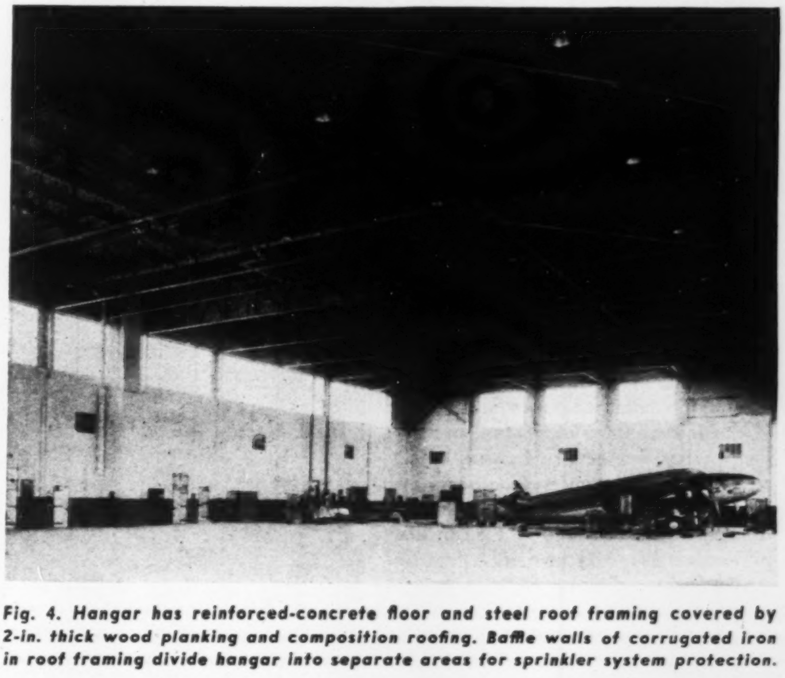


Fig. 4. Hangar has reinforced-concrete floor and steel roof framing covered by 2-in. thick wood planking and composition roofing. Baffle walls of corrugated iron in roof framing divide hangar into separate areas for sprinkler system protection.

Safety in Powder Plant Construction

***Contents in Brief**—Enthusiasm for safety has taken the place of enforcement of regulations on the construction of an ordance plant in Alabama, where a public-address system is one of the means used to give workers daily encouragement and instruction. Safety goggles are issued to each man and all workmen are urged to wear hard hats, special shoes and gloves. The safety department's word is law on this project but orders are not needed since the men have been "sold" on the merit of keeping the job safe for themselves and their fellow workers.*

PLANNED CAMPAIGNS and procedures have replaced the haphazardly posted Safety First slogan on many construction jobs. But on an ordnance plant project in Alabama, real job enthusiasm has been built up for working safely, and it has resulted in a better job morale as well as an accumulated 5,775,200 man-hours of activity without a lost-time accident.

Among other things each man is given a pair of safety goggles and those working underneath construction operations are supplied with hard hats. The men are encouraged to wear safety shoes and can buy, at the plant, a good grade of hard-toe shoe at a price that makes wearing them as economical as ordinary shoes purchased elsewhere. Workers are encouraged to wear gloves except when it is absolutely necessary to avoid them; carpenters on form construction are asked to put gloves on for all lumber handling, and they are expected to wear them most of the time on concrete form work.

An innovation in "selling" safety is a public-address system at the clock alleys or gates through which the workmen pass for identification and checking in and out of the work. Most of the 15,000 to 25,000 employees are on the day shift and pass through the gate area at the start and close of the working time. The loudspeaker installation takes advantage of the few minutes of general assembly when the men are in line twice a day. One of the safety engineers or superintendents talks safety, mentions special hazards to be met on the particular day, and probably puts in a plug for use of proper hats, goggles, gloves and shoes. As the men are leaving at the end of the shift a member of the Alabama Highway Patrol talks safety on the road, or the men are given suggestions for health care and prevention of off-the-job accidents. Often martial music is broadcast, the steady tempo having marked effect in controlling movement through the clock alleys. Running and horseplay absolutely are prohibited and the loudspeaker effectively cautions "the man in the blue shirt at Alley 46" for rushing. Bantering comment of the fellow workmen in the line adds to the rebuke and few repeaters are found.

Most important of all, these schemes have worked because the men are really sold on the idea of safety. Construction men usually profess contempt for the new or nervous man who cannot climb the highest ladder or walk a beam—but not on this job! Here both men and supervisors have been taught the value of safety and believe in its fundamental economy so that all work together to achieve safety and to help the new man learn the safe way, not the daring way, to do his work.

Distinctive hard hats

The safety section on the ordnance work consists of several full-time men, mostly engineers (but not limited to engineers), assisted by all of the supervisory forces. Full time safety men wear distinctive hard hats, painted white with a green cross. These men are assigned to the work in each of several areas but are shifted frequently to get, as well as give, a new viewpoint. Safety engineers have absolute authority to stop any operation not fully complying with safe work practices but the authority is seldom used as suggestions are sufficient to obtain immediate correction of doubtful practices. The safety men check all devices, falsework and trench openings

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Fig. 1. Interior form erected for one of the many buildings. Safety stairs are built to all levels as the initial step in construction operations.

to see that they are properly protected or marked, and report on all accidents, but their chief work is training the men and selling the safety program.

When a new employee first comes to the work he joins other incoming men in an orientation meeting at which the merits of safety are outlined, available tools and clothing are described, and the new employee given a handbook of safe practices. The man continues to hear of safety at regular meetings held by each subforeman with his gang. These meetings are held from 8:00 to 8:15 on Monday morning at which a weekly safety report is read and special hazards outlined. Each man is given a mimeographed folder of safety ideas and each gang is urged to encourage the use of hard-toe shoes, gloves and hard hats.

A short description of the project and the construction forces on the work is perhaps desirable for an understanding of the safety set-up at this plant. Briefly, the ordnance work is divided into a smokeless powder area and a high explosive area. (Most construction men think of any powder as high explosive but ordnance men speak of smokeless as "slow burning.")

The plant is being built on a rolling section of land near a large river to assure an adequate water supply and near two main line railroads to provide transportation. Most of the buildings are relatively small and are generally of semi-permanent frame and sheet-metal construction set on concrete foundations.

Much of the manufacturing for production of powder takes place in a few buildings fairly close together and grouped around nitrating buildings. As the processing continues the materials become increasingly volatile and the buildings are separated farther and farther with the blending towers and storage buildings several hundred feet apart. Track connects most of the buildings, the plan being to transport nearly all materials in cars operating on rails.

The construction contractor's organization is headed by a project manager and assistant project manager, and is then broken down into five divisions covering: cotton preparation, acid buildings, power plants, powder and service organizations. Each of these is headed by a general superintendent who is responsible for all the work on such construction wherever located. Area engineers head up the work in a geographical area, usually along a powder line, taking care that all items are moving properly and that necessary materials are available as required. Next in line of authority are craft superintendents who have complete control of the men in the various crafts, directing where each crew shall work and being responsible for their production. These men cover the particular craft regardless of where the men are working. Area superintendents, working under the general superintendent, direct the work in each section on about the same division as the area engineers. The men in the various crafts are in gangs with a maximum of 16 men to a foreman.

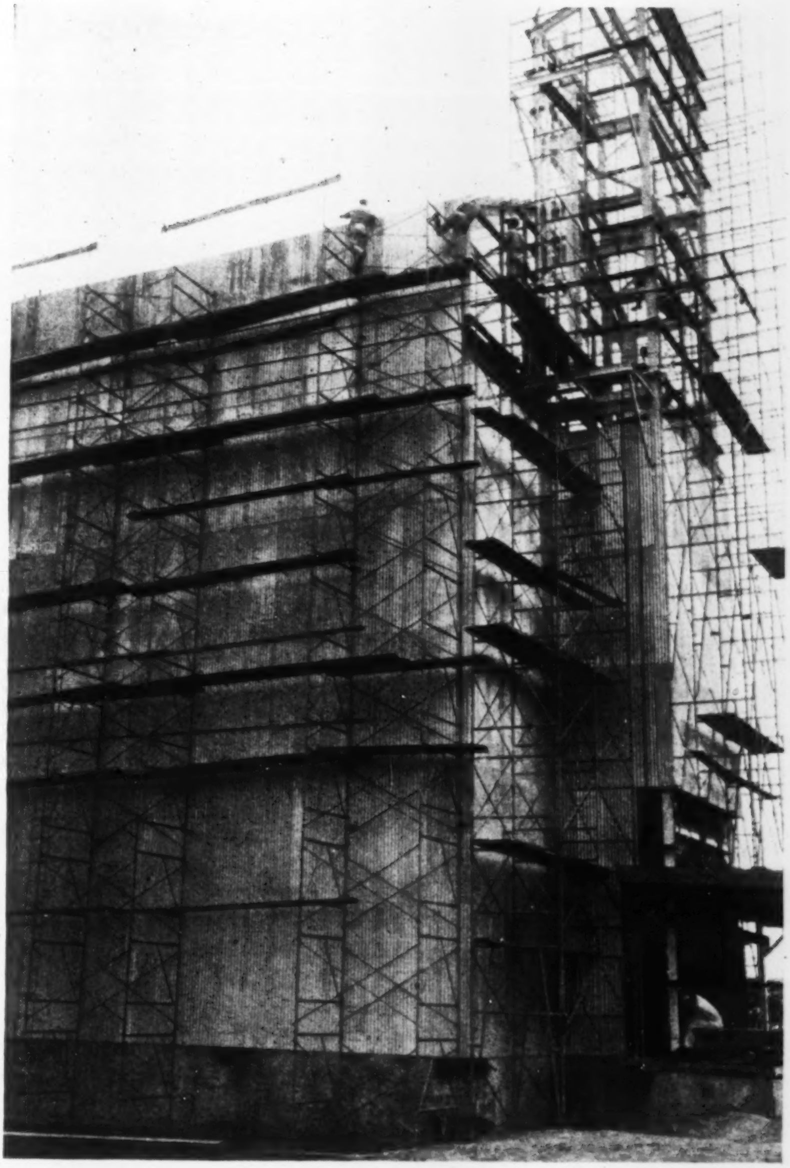


Fig. 2. Steel safety scaffold is used for the construction of all tall buildings.

Good ideas passed around

This inter- and overlapping of supervision quickly carries the best of construction and safety ideas from one part of the work to all other sections. Having the superintendents' and the top engineers' work divided on a different basis brings each of them in contact with all of the new ideas and better practices of the others. This disseminates information on better construction methods and speed-up practices much more rapidly than could be done by a general superintendent working alone or by use of bulletins.

All of the supervisory forces devote regular time to the safety program. Sub-foremen have a meeting with the safety engineer just after the shift finishes work on Thursday. The craft superintendents discuss safety for 15 minutes at the regular staff meeting on Friday. The area engineers and superintendents have safety as a major part of their discussion at regular meetings. From these meetings the safety engineers get their support and their ideas for many constructive suggestions which are passed on to all employees.

The safety department keeps a card for each man on which is recorded each accident, even those that require nothing more than a dab of iodine. Accident-prone cases are watched, suggestions offered and where necessary, remedial measures are taken to keep the accident rate down. All men are encouraged to report for work if able, despite injuries, and are temporarily assigned to jobs which they can perform. This brings them to the job for proper medical attention, keeps up the morale, and generally lessens the time they are away from their regular duties.

The job is kept safety conscious by inter-craft and inter-area competitions that last from 60 to 90 days. The areas or crafts successful in preventing lost-time accidents are rewarded with cups, suitably engraved certificates, and by prominent mention in the plant paper. Commendation is given to crews having all of their workers in safety shoes, and special notice is given to any particular practices that add to the safety of the job. Pennants flying from trucks and buildings, use of the public-address system, and the regular safety meetings keep the men constantly "on their toes." It all adds up to a safety-conscious and unusually safe job.

Personnel

The Army forces responsible for this activity are headed by Lt. Col. J. D. McIntyre, Ordnance Department, commanding officer and project engineer; Lt. Col. Albertis Montgomery, Corps of Engineers, assistant project engineer and chief of the engineering and operations branch; Capt. I. T. Malmstrom, Ordnance Department, executive officer; C. H. Dexter, administrative assistant; and Charles J. Maxcy, chief project auditor.

Underground Storage for Floods Assures Army Camp Water Supply

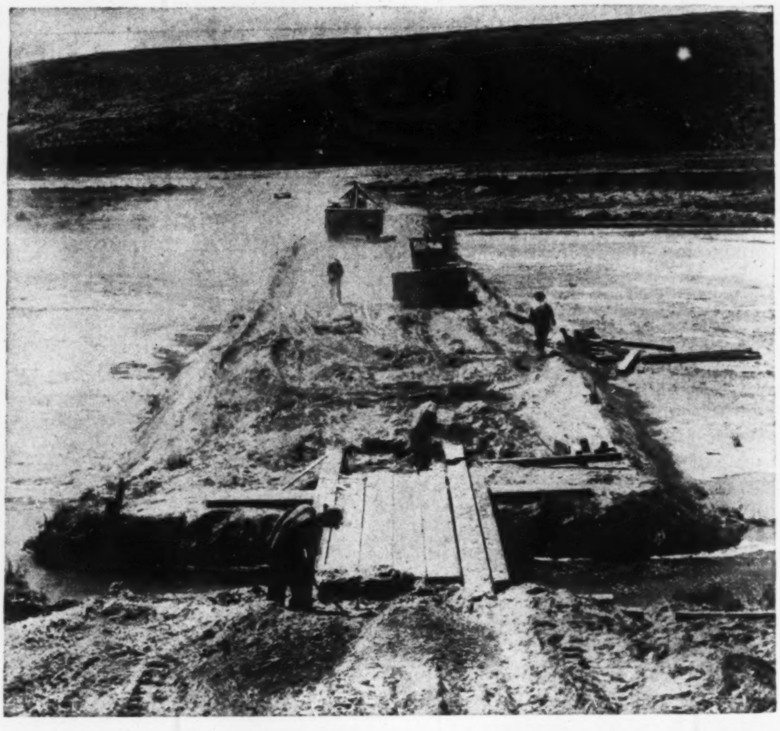
Clarence G. Beardslee

Public Relations Section, Branch Office, U. S. District Engineer,
San Francisco, Calif.

Contents in Brief *— Wastage of flood waters, water scarcity in dry years, and menacing salt water incursion have all been remedied on the Santa Ynez River in California by a low weir at a strategic location. The result not only assures the supply for a 35,000-man army camp but improves water-supply conditions in adjacent areas.*

DEVELOPMENT OF A WATER SUPPLY adequate for 35,000 men that ultimately will be quartered at Camp Cooke in California included construction of a water barrier that has revised the hydraulic characteristics of the area near the mouth of the Santa Ynez River. At a cost of only about $300,000, this simple low weir-type structure accomplishes the multiple purpose of retaining and spreading flood waters that formerly wasted into the sea, raising the water table in a considerable area by means of infiltration and percolation, and in periods of severe drought the structure prevents the incursion of salt water at high-tide levels into the underground storage basins, spoiling them for domestic use.

Camp Cooke is located on a 92,000-acre reservation for which the most promising source of water supply, when the camp was laid out, was the Santa Ynez River whose 900-square mile drainage basin produces an annual runoff that has varied in 37 years from 46,000 to 349,000 acre-ft. The larger floods have flowed into the sea without restraint, except for Gibraltar Dam (*ENR* May 20, 1920 p. 1003) which stores water for the cities of Santa Barbara and Montecito. Total demands on Santa Ynez streamflow represented by prior claims to water are only about 23,000 acre-ft. annually.



Making the earthfill for the barrier dam. Two parallel lines of Wakefield piling, 15 ft. apart, were later driven in this fill.

Underlying most of the irrigable land near Camp Cooke are sands and gravels which can be replenished each year by flood flows of the Santa Ynez. It was therefore soon apparent, when planning for the camp, that an increased period of percolation during high-water seasons would materially increase the water available from natural underground storage.

To assure a dependable supply of 6,000 acre-ft. per annum, estimated as the desirable ultimate camp supply, a group of five wells was located in the westerly half of the basin where the water table ranges from 5 to 25 ft. above mean sea level. The underground supply here available, however, could not be relied upon in dry years with hydraulic conditions as they were, nor could assurance be had in such years against the incursion of salt water without some means of controlling the hydraulic balance in the lower portion of the river channel.

Fortunately, a sub-surface blanket of clay was found to cross the Santa Ynez River basin near the mouth of the river at a point where the channel is only about 3,000 ft. wide. The menace of salt-water incursion is limited to inflow through this neck and it is here, also, that the flood flows escape to the sea. Accordingly, a low, impervious barrier some 3,000 ft. long has been built across this neck about a mile inshore from the beach, including two dikes and a central or channel section 1,100 ft. wide.

Fill held by Wakefield piling

In the channel section a fill to the desired height was placed first and then two rows of Wakefield timber piling, 15 ft. apart, were driven down well into the impervious clay layers. A pile length of 30 ft. made the height right for a concrete slab poured on top of the fill and for bonding the two rows of piling. This concrete capping serves to fix and control the outlet level (or spillway lip) for impounded flood waters. A timber trestle built on the concrete base thus formed carries a two-lane roadway across the channel section.

The dikes extend 1,240 ft. to the north and 600 ft. to the south and act as wing walls on either side of the channel. They consist of rolled fills made on ground stripped to a 3-ft. depth before the filling began. The wings are both capped by a concrete parapet carried up 5 ft. above high tide. With river channel outlet controlled in this way, salt water will be kept out and flood waters will be ponded for some time after the winter floods, materially increasing the infiltration into subterranean storages.

Thus, unlike much of the defense construction which will have fulfilled its purpose when the present national emergency ends, this improvement will be of permanent value in providing a dependable water supply for land that will have increasing need of it.

With replenishment of groundwater thus assured and salt water excluded, the wells are expected to be an adequate and dependable source. The pumps that lift water from them deliver through a common discharge line to a booster pumping station at about El. 60, whence a 24-in. concrete high-pressure main leads to the cantonment area, roughly 400 ft. higher. At that point the 24-in. line divides, passing generally on opposite sides of the area occupied by camp buildings to two four-million-gallon concrete tanks located some distance farther up the ridge at El. 600. From this high-level storage there is gravity service to all parts of the camp.

The project is being carried out under direction of Leeds, Barnard, Hill and Jewett by whom the architect-engineer contract is held. Construction is under contract to the combined firm of Ford J. Twaits and Morrison-Knudsen & Co.

Maintenance of Steel Water Tanks

Since maintenance work on elevated steel water tanks has been reduced to a minimum by modern design and construction, little more than periodical inspection and painting is now required, according to Edward E. Alt of the Chicago Bridge & Iron Works in an address before the Illinois Water Plant Operators Conference. He said that the ideal plan for municipalities is to have an ordinance creating a regular tank-painting program.

The program should provide for careful inspection and necessary painting every four or five years. On the first painting after erection, it will probably be found that the mill scale has loosened and fallen off, and the following work will be needed: (1) wire brush, and scrape inside and outside surfaces, removing loose scale with ball pean hammers; (2) spot paint all steel surfaces thus exposed; (3) paint inside of tank one coat of red-lead paint, and outside one coat of black or bronze-green graphite paint, or a finish coat as desired. On subsequent paintings the same procedure should be followed. Ready-mixed, red-lead paint is preferable for the inside work, as paint prepared on the job may be too light or too heavy a mixture. If the original outside paint was aluminum or other light color, a similar paint may be used. It is impossible now to obtain aluminum paint, but there are other satisfactory light-color tank paints available.

Of some 400 experimental samples of paints for the inside of tanks, those with lead bases have averaged better than three to one over varnishes and other products. Mr. Alt considers that some linings might be better than the red lead, but that the cost of material and application is prohibitive, and the finished job not sufficiently better to warrant the additional expense.

The most recent form of protection against corrosion is the electro-chemical or cathodic system, in which an electrode suspended from the roof extends down through the water. This electrode serves as the positive pole of an electric cell, with the water as the electrolyte and the tank as the negative pole. With an electrical connection to the electrode, there is a constant flow of current from the water to the tank shell, on which a film of hydrogen is deposited, preventing corrosion. The cost is about $1 per month for current at a tank of 50,000 to 100,000 gal. capacity, and the tank is kept in continual service, since drainage for inspection and painting is not necessary.

Sterilization of steel tanks after erection or after repair work is required by the Illinois Department of Public Health, and before the sterilizing solution is admitted, the steel surface should be made as clean as possible. The recommended sterilizing solution contains at least 50 ppm. of available chlorine, and should remain at least five hours, and preferably overnight.

Analyzing Flow from Multiple Reservoirs By the Hardy Cross Method

J. F. Muir
Associate Professor of Civil Engineering
University of British Columbia, Vancouver

Contents in Brief*—A method free of complex mathematical relations is developed for application of the Hardy Cross method to determination of flow from a multiple-reservoir system. Also described is actual application of the method to a three-reservoir problem, the step-by-step procedure being illustrated.*

JUST as the Hardy Cross method may be applied to problems of flow distribution and head losses in pipe networks (*ENR*, Oct. 1, 1936; p. 475; March 3, 1938, p. 342, and Jan. 1, 1942, p. 41), the method may also be applied to problems of flow distribution from a number of elevated storage reservoirs supplying water to a distribution main. Algebraic methods, involving the solution of simultaneous equations, may be adequate for simple reservoir problems, but when computing flows from three or more reservoirs, discharging through compound pipes into a distributing main, the flow equations become unwieldy. This is particularly true in applying pipe-flow formulas, such as Hazen and Williams, requiring logarithms for their solution.

In employing the Hardy Cross technique for the solution of multiple-reservoir problems no complex mathematical relations are involved. It is convenient to have available a set of tables or charts giving friction losses per 1,000 ft. of pipe. The labor, other than the reading of tables or charts, involves only simple arithmetic.

In the analysis which follows, the method will be applied to a three-reservoir problem. Problems involving four or more reservoirs may be readily solved, although each additional reservoir increases considerably the incidental labor of calculation. The nomenclature adopted is similar to that used by Gordon M. Fair in analyzing flow in pipe networks (See *ENR* March 3, 1938, p. 342).

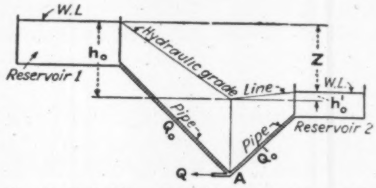


Fig. 1. Relative elevations of reservoirs in a two-reservoir layout.

In Fig. 1 is shown the relative locations of reservoirs 1 and 2 and the

Pipe Data				Assumed Flows						First Correction, Branch 1						First Correction, Branch 2					
Branch	Pipe No.	Length Ft.	Dia. Inches	Q_o gpm.	$\frac{h^*}{1,000}$	h_o Ft.	Z Ft.	$\frac{h_o}{Q_o}$	Δ_o	Q_1 gpm.	$\frac{h^*}{1,000}$	h_1 Ft.	Z. Ft.	$\frac{h_1}{Q_1}$	Δ_1	Q_2 gpm.	$\frac{h^*}{1,000}$	h_2 Ft.	Z Ft.	$\frac{h_2}{Q_2}$	Δ_2
1	1	3,000	12	+2,500	22.44	+67.3		0.0269	+1,235	+3,735					−161	+3,574	43.52	+130.6		0.0365	−88
	2	1,000	8	+200	1.51	−1.5		0.0075	−1,235	−1,035						−1,035	31.43	+31.4		0.0304	+88
	3	500	10	+1,500	21.12	−10.6		0.0071	−1,235	+265					+161	+426	2.06	−1.0		0.0024	+88
							−150												−150		
					Δ_o =	+94.8÷	1.85×	0.0415=	+1,235								Δ_2 =	−11.0 ÷	1.85 ×	0.0693 =	−88
2	1	3,000	12	+2,500					+1,235	+3,735	47.38	+142.1		0.0381	−161	+3,574					−88
	4	4,000	10	+1,300						+1,300	16.26	−65.0		0.0500	+161	+1,461					
	3	500	10	+1,500					−1,235	+265	0.86	−0.4		0.0015	+161	+426					+88
													−50								
											Δ_1 =	−26.7÷	1.85×	0.0896 =	−161						

Second Correction, Branch 1							Second Correction, Branch 2						Third Correction, Branch 1						Final Result			
Pipe	Q_3 gpm.	$\frac{h^*}{1,000}$	h_3 Ft.	Z Ft.	$\frac{h_3}{Q_3}$	Δ_3	Q_4 gpm.	$\frac{h^*}{1,000}$	h_4 Ft.	Z Ft.	$\frac{h_4}{Q_4}$	Δ_4	Q_5 gpm.	$\frac{h^*}{1,000}$	h_5 Ft.	Z Ft	$\frac{h_5}{Q_5}$	Δ_5	Q	$\frac{h^*}{1,000}$	h Ft.	Z Ft.
1	+3,486					+47	+3,533	42.51	+127.5		0.0361	−24	+3,509					+12	+3,521	42.18	+126.5	
2	−947						−947	26.66	+26.7		0.0282	+24	−923						−923	25.54	+25.5	
3	+514					−47	+467	2.44	−1.2		0.0026	+24	+491					−12	+479	2.57	−1.3	
										−150												−150
								Δ_4=	−3.0 ÷	1.85×	0.0669=	−24									+0.7	
1	+3486	41.51	+124.5		0.0357	+47	+3,533					−24	+3,509	41.84	+125.5		0.0357	+12	+3521	42.18	+126.5	
4	+1461	20.27	−81.1		0.0555	−47	+1,414						+1,414	19.08	−76.3		0.0540	−12	+1,402	18.74	−75.0	
3	+514	2.93	−1.5		0.0024	−47	+467					+24	+491	2.68	−1.3		0.0026	−12	+479	2.57	−1.3	
				−50												−50						−50
		Δ_3=	+8.1÷	1.85×	0.0941=	+47								Δ_5 =	+2.1÷	1.85×	0.0923=	+12			+0.2	

* $\frac{h}{1,000}$ = *Friction loss per 1,000 ft. pipe Hazen & Williams C=100* $\Delta = -\frac{\Sigma h - Z}{1.85\,\Sigma \frac{h}{Q}}$

Table 1. Calculations to determine the successive corrections required in analyzing the flow distribution in the three-reservoir problem illustrated in Fig. 2.

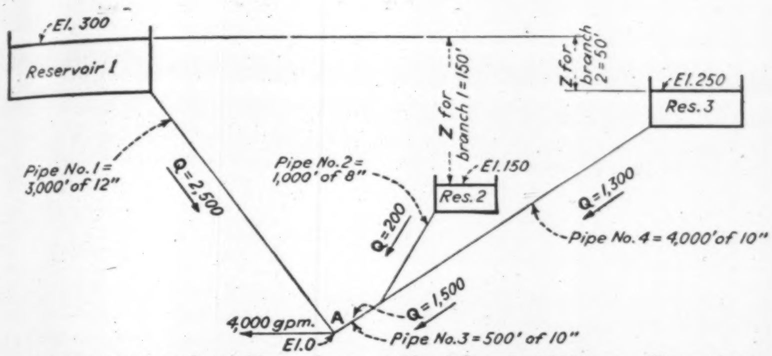


Fig. 2. Three-reservoir problem where combined flow is 4,000 gpm. Flows shown from the individual reservoirs are assumed. Table 1 gives calculations required in applying the Hardy Cross method to determine the actual flow from the individual reservoirs and the head losses in the interconnecting pipes.

combined flow from the two reservoirs at Point A has been designated. It is required to find the flows and head losses in the pipes connecting the reservoirs.

Solution

At any pipe junction the quantity of water flowing into the junction must equal the flow away from the junction. Assume then that the quantities Q_o and Q'_o, the sum of which must equal Q, flow through the pipes as indicated. If these flow assumptions are correct, then the head loss h_o resulting from the flow Q_o must equal the head loss h'_o resulting from the flow Q'_o, plus the height Z. This is because the hydraulic grades at A must be the same, regardless of which pipe is considered.

$$\text{Then } Q_o + Q'_o = Q \text{ and } h_o = h'_o + Z \text{ or } h_o - h'_o - Z = 0$$

If the first assumptions are not correct then a correction Δ_o must be applied to Q_o and Q'_o and the flows become $Q_o + \Delta_o$ and $Q'_o - \Delta_o$. The head loss h in any pipe of known diameter and length may be expressed in the form $h = kQ^n$. For example, in the Hazen and Williams formula, $h = kQ^{1.85}$. It follows that

$$h_o - h'_o - Z = k\,(Q_o + \Delta_o)^n - k'\,(Q'_o - \Delta_o)^n - Z = 0 \text{ and}$$

$$k\,(Q_o^n + n\Delta_o Q_o^{n-1} + \ldots) - k'\,(Q'^n_o - n\Delta_o Q'^{n-1}_o + - \ldots) - Z = 0$$

If Δ_o is small compared to Q_o and Q'_o, the remaining terms of the expression may be neglected. Thus,

$$\Delta_o = -\frac{+kQ_o^n - k'Q'^n_o - Z}{k\,n\,Q_o^{n-1} + k'\,n\,Q'^{n-1}_o}$$

, or, in general $\Delta_o =$

$$-\frac{\Sigma\, k\,Q_o^n - Z \text{ (attention to flow direction)}}{n\,\Sigma\, k\,Q_o^{n-1} \text{ (no regard to flow direction)}}$$

$$\text{Since } k\,Q_o^n = h_o \text{ and } k\,Q_o^{n-1} = \frac{h_o}{Q_o},$$

$$\Delta_o = -\frac{\Sigma\, h_o - Z \text{ (with attention to flow direction)}}{n \sum \frac{h_o}{Q_o} \text{ (without regard to flow direction)}}$$

If the first correction does not balance the head losses, subsequent corrections are applied to the flows until the system is balanced to any desired degree of precision.

Conventions regarding positive and negative signs to be used in the last equation given include: (1) Flows from the upper reservoir, always toward the reference point A, are considered positive and head losses caused by these flows are also positive; (2) Flows from lower reservoir toward A are positive and reversed flows are negative. When flow is toward A, the head loss is negative, while reversed flows cause positive head losses; (3) Correction Δ_o obtained from the last equation listed is to be applied to the flow in the pipe serving the upper reservoir. Correction for the other pipe flow will evidently be equal but of opposite sign.

In Table I is shown the computations for the three-reservoir problem illustrated in Fig. 2, where it is assumed that 4,000 gpm are discharging from the system at A. The assumed flows in the various pipes are indicated in the diagram. Hazen and Williams, tables with C = 100, were used to determine the friction losses.

Referring to Fig. 2, the procedure is to combine the upper reservoir alternately with each of the other two. In grouping the pipes and reservoirs it is assumed that branch 1 is made up of reservoirs 1 and 2 and pipes 1, 2 and 3, while branch 2 consists of reservoirs 1 and 3 and pipes 1, 3 and 4. Point A has been chosen as the most convenient reference point, although any point common to the two branches may be so chosen, providing the conventions as to sign are consistently followed.

The first correction is to be applied to the flows in the pipes serving branch 1. When the flows in these pipes have been revised accordingly, the first flow correction to the pipes in branch 2 is then calculated. Since pipes 1 and 3 are common to both branches, it follows that the flows in these pipes must be revised when each correction to either branch is made.

Determination of the correct flow is very rapid, as illustrated by Table 1. In the example chosen, three corrections to the flows in each branch are sufficient to reduce the error beyond the limits of accuracy usually required in practice. The tabulated values under the heading "final result" indicate that the flow in pipe 2 is — 923 gpm., showing that reservoir 2 is filling by this amount. Flows in all other pipes are toward the reference point.

The pressure at any point in either of the branches may be readily determined. For example, the pressure at A equals elevation of the water surface in reservoir 1 minus the head losses in pipe 1 or 300 ft. — 126.5 ft. = 173.5 ft.

Street-Car Rails Salvaged for Steel Scrap

Atlanta, and Seattle and Bellingham, Wash., have been added to the growing list of cities salvaging abandoned street-car rails to provide iron and steel scrap for armament purposes, according to the American Public Works Association. Plans are nearing completion in Atlanta for salvaging about 33 miles of unused track. WPA labor will be used in removing the rails, which city officials say can be sold for $70,000. The Georgia Power Co. has agreed to give the rails to the city, the $70,000 applying as the city's part of repaving costs. The track probably will be removed a block at a time to avoid obstructing traffic.

Seattle and Bellingham are removing 16,000 and 12,000 tons of abandoned rails respectively, with the WPA providing the labor for salvaging and resurfacing.

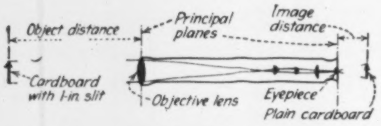
Determining Telescope Magnification by the Principal Planes Method

Lynn W. Jones
Department of Engineering,
University of Redlands, Redlands, Calif.

EXPERIENCE in teaching surveying over a period of years has indicated the need of a simple method for finding a telescope's magnifying power without requiring:

1. Special eye technique to determine the number of diameters the telescope magnifies an object.
2. Knowledge of optics and the refined measuring equipment involved in the aperture method.
3. Dissembling of the telescope to measure the focal lengths of the objective and eyepiece, which are required by the focal-length method.
4. Use of a second telescope and the difficult set-up as required in the tangent method.

The writer has found that a procedure based upon the optical laws of the principal planes is very satisfactory, while being as exact as the other methods and having the advantage of easy manipulation. To calculate the magnifying power by this method a 1-in. long slit is cut in a piece of cardboard, the cardboard placed perpendicular to the line of sight about 8 ft. from the objective lens of the telescope, and then the slit illuminated from behind with a bright incandescent lamp. A plain white cardboard of any shape is then held back of the eyepiece in a plane perpendicular to the line of sight and the cardboard moved back and forth until the image is 1-in. long or the same size as the slit. The telescope's magnifying power (see sketch) is



then the ratio of the distance from the slit to the objective lens and the distance from the image to the eyepiece, or the magnifying power =

$$\frac{\text{objective distance}}{\text{image distance}}$$

This ratio makes use of the theory of principal planes, from the work of Gauss, and the method allows one to eliminate the central portion of the lens, i.e., the portion between the objective lens and the eyepiece.

As a check, two transits were calibrated by the new method and by the other methods mentioned. Comparison of the average results for several measurements by the various methods are given by the accompanying table, which also gives the magnifying powers of the transits as furnished by the manufacturer.

COMPARISON OF CALIBRATION METHODS

Methods of measuring magnifying power	Magnifying powers	
	Transit (A)	Transit (B)
Principal planes	17.0	22.4
Number of diameters of enlargement	17.2	22.6
Apertures	15.7	21.9
Tangents	15.5	20.8
Manufacturer's values	17	22

In calibrating Transit (A) by the principal planes method, 24 readings were taken as the objective distance was varied from 3.65 to 14.80 ft. The magnification power determined ranged from 14.9 to 18.2. With Transit (B) the power of magnification ranged from 21.2 to 22.9 as 16 readings were taken with the objective distance varied from 5.49 to 16.40 ft.

By the diameters-of-enlargement method the readings were taken with a target and adjusted to three significant figures. For Transit (A), five readings showed a range in the magnification power of from 16.7 to 17.7, while with Transit (B) ten readings revealed a range of 20.5 to 24.1.

With the aperture method the sizes of the apertures were checked and found to be the same as furnished by the manufacturers. The diameters of the images of the clear apertures were then measured with a cathetometer reading to three decimals and four measurements were taken for each instrument.

In the tangent-method measurements a fluorescent light about 20 ft. from the transits was used as the subtended angle, since the edges of the light were definitely outlined. Only one set of readings was taken for each transit with this method.

By comparing the results of the various calibration methods it can be concluded that the magnifying power secured by the method of principal planes is sufficiently exact and that this method has the advantage of easy manipulation, while the other methods require either expensive auxiliary equipment or special techniques.

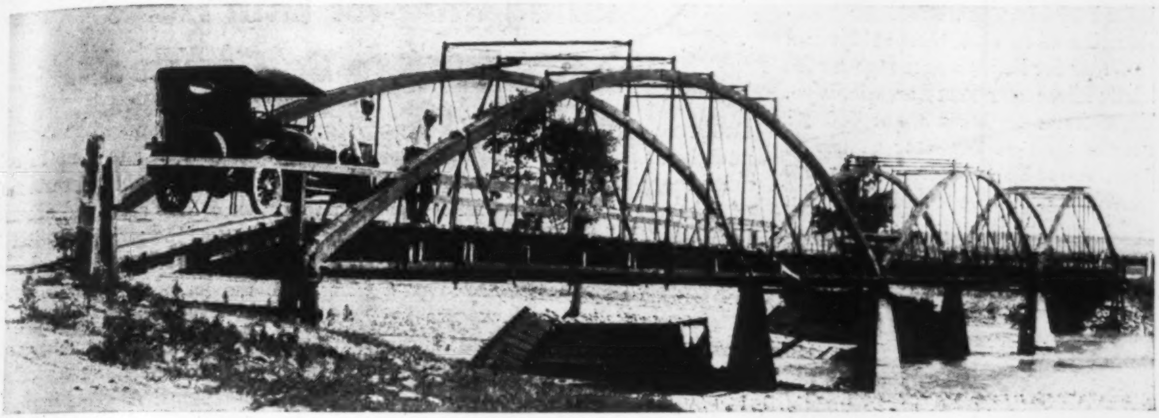
Photographic Method for Inspecting Welds

A new photographic method for inspecting welding work has been developed by C. A. Dunn, professor of engineering at Oklahoma A. & M. College, Stillwater, Okla. Airplane factories, shipyards and many other concerns engaged in national defense work may eventually benefit from his work.

Working in cooperation with the Eastman Kodak Co., Prof. Dunn found that welds could be photographed, although many difficulties were encountered in attempting to photograph such work; and that such factors as size and shape of molten pool, arc length, indication of fusion, undercutting, etc., could be distinguished in different quality welds. The intense light produced by the electric arc necessitated the use of a camera filter. A filter permitting only 10 percent of the light to reach the film gave the best results—clear details and little glare. Color film was also tried, but the smoke from the burning electrode made a blue color to which color film was sensitive, obscuring some important details of the welding.

The automatic camera was next considered. Although Prof. Dunn learned from camera experts that there was no photographic reason why a camera could not be installed in an electrode holder, as yet the design of the photo-electrode holder has not been completed.

The present phase of Prof. Dunn's research is an effort to adapt sound to the pictures. The sound of the arc is useful to the welder and inspector in passing judgment on the photographic process. Prof. Dunn believes that the first important use of the photographic process will probably be in training courses for student welders and inspectors.



Wyoming's oldest bridge, of wrought-iron trusses and wooden floor system, has a service record of 66 years.

Saga of Wyoming's Oldest Bridge

***Contents in Brief**—One of the first metal bridges west of Missouri River is still in service in Wyoming. Now over 65 years old, it has wrought-iron trusses and a timber floor system. Two spans are 125 ft. and one is 150 ft. Roadway width is 11 ft. and design line load was 1,100 lb. per lin. ft.*

How Political Intrigue, financing difficulties, and other delays outside the engineer's control, affected the construction of our small pioneer bridges—much as they have played a part in the building of monumental crossings of more recent times—is illustrated in the life history of the 400-ft. structure over the Platte River on the road leading to Fort Laramie (Wyo.), National Monument. Opened to traffic in 1876 and still in service, this three-span structure is considered to be the first highway bridge in Wyoming with metal trusses, and one of the oldest bridges west of the Missouri River. It was known in the early days as the "engineer bridge" because of its contrast with the timber structures common in those times.

Some facts concerning its design are as follows: Panel length of the 125-ft. long end spans vary from 7 to 10 ft. and the rise in the top chord is 12.3 ft. The 150-ft. center span has panel lengths varying from 8 to 10 ft., while the rise is 17 ft. In all spans each upper chord is made up of two 8-in. wide wrought-iron channels and two wrought-iron plates varying in thickness from $\frac{3}{8}$ to $\frac{7}{16}$ in. and $10\frac{5}{8}$ to 12 in. in width. Vertical and diagonal members are wrought-iron rods and each bottom chord consists of two strap irons 1 in. thick and 4 to 5 in. wide. The floor-beams are made up of two 6x12-in. untreated timbers at each panel point, the longitudinal stringers of seven lines of 6x8-in. untreated timbers, and the flooring of 3x12-in. planking. A clear roadway width of 11 ft. is provided, while the vertical clearance is $13\frac{1}{4}$ ft.

The wrought-iron bents used for the piers and abutments were bolted to grillage foundations resting well below low-water level on a compact and level stratum of hardpan and boulders. To increase the mass of the piers, the grillages were surmounted by a substantial stone-filled crib work and a stone-filled crib was placed upstream of each pier. Later the piers were encased in concrete, probably about 1915, but the crib ice breakers are still used. The truss bearings are pin connected to cast-iron shoes bolted upon the caps of the bents. The clearance below the bottom chord is 17.5 ft.

Built by the Army

The Quartermaster Corps, U. S. Army, built the bridge, following an investigation of the site by Capt. W. S. Stanton, Corps of Engineers. The three wrought-iron bowstring trusses were fabricated by Z. King & Son, Cleveland, Ohio. They were shipped via the Union Pacific R.R. to Camp Carlin, an old military post located about four miles northwest of Cheyenne on Crow Creek, and then transported to the site by mule team. The load designed for was 100 lb. per sq. ft, of roadway or 1,100 lb. per lin. ft. of bridge, with a safety factor of four required. When complete, the crossing was tested by loading each span successively with a group of thirteen army wagons loaded with stone or a total load of 98,200 lb.

Construction of the bridge is an interesting story of political intrigue in the fight between businessmen of Cheyenne, Wyo., and Omaha, Neb., for control of the trading contracts to supply the Red Cloud and Spotted Tail Indian agencies. As early as February, 1873, the Cheyenne *Leader* urged the citizens of the Wyoming territory to construct a ferry across the Platte on the road leading to the Indian agencies. About a year later or March 3, 1874, Col. W. R. Steele, delegate in Congress for the Wyoming territory, introduced before that body a bill for "location and construction of a government military bridge across the North Platte River at Fort Laramie, Wyoming Territory . . . Not to cost more than $15,000."

Construction of the crossing was recommended by Generals Sheridan and Ord and on June 23, 1874, Congress passed the desired appropriation. July 3 General Ord received instructions from the War Department to prepare plans and specifications for the bridge. Bids were to be submitted by Aug. 10, 1874, for "construction of an open truss bridge and roadway for heavy wagons across the Platte River near Fort Laramie, Wyo. From bank to bank about 410 ft; deepest part of the river to top of bank about 15 ft.; bottom is coarse gravel and cobble stones; current swift and unchangeable; water at ordinary stage 3½ ft. deep at deepest place. Substructure should be crib work or piling resting on mud sills. Pine timber in abundance is within 45 miles of the point."

Soon afterward plans for a wrought-iron bridge with stone piers and abutments were approved by General Ord and he designated Captain Stanton to superintendend construction.

Construction slow

When no construction had been carried out by Nov. 24, Colonel Steele called upon General Sheridan in Chicago to urge immediate resumption of work. But nothing was done and the Cheyenne *Leader* Jan. 28, 1875, reported "Will the commanding officer of the Department of the Platte carry out the purpose of Congress in making a $15,000 appropriation to bridge the North Platte River at or near Fort Laramie or will he endeavor to defeat that purpose in the interests of the Omaha military ring?"

However, on Feb. 22, 1875, the *Leader* made known "The new bridge for the Platte at Fort Laramie is now en route to that place, and the abutments and piers have not yet been constructed."

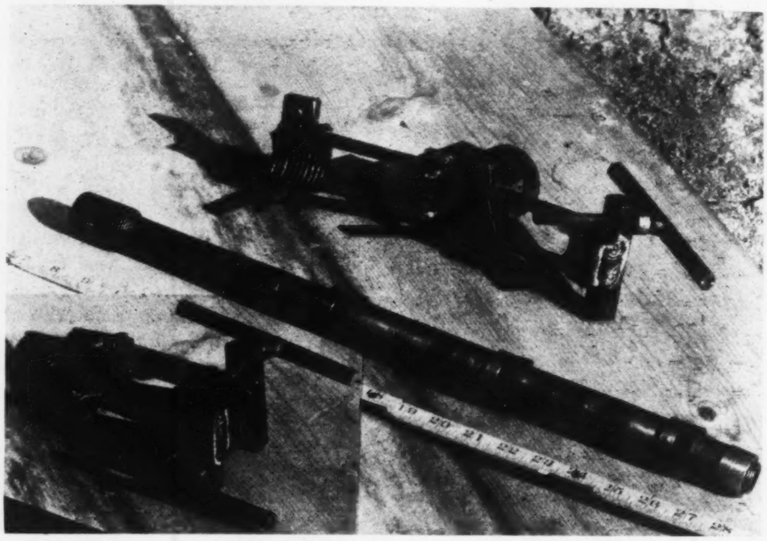
In the meantime, the quartermaster at Fort Laramie was ordered to get the ferry in readiness for use during high water in the spring of 1875 and on April 27 of that year the North Platte was reported to be "entirely unfordable" and the only way of crossing the stream was by ferry at Fort Laramie or by skiff at the Janis ranch located about 30 miles below the fort.

The *Leader* June 3, 1875, revealed that work on the abutments and piers was scheduled to begin about Aug. 1 and Nov. 30 the bridge was described as completed. At the beginning of 1876 the crossing was opened to traffic and though for a time the military officials endeavored to collect tolls, this practice was soon stopped through the efforts of Colonel Steele.

Sliding Plug for Drill Holes Limits Zone to Be Grouted

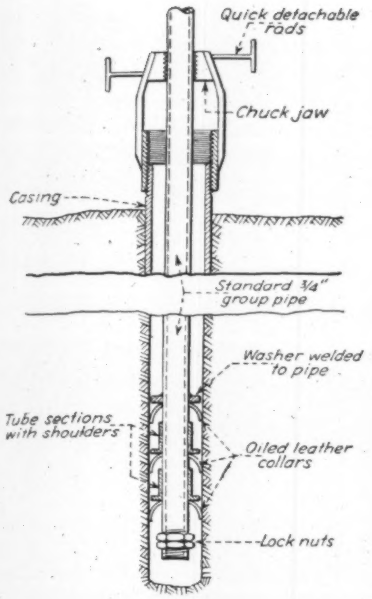
GROUTING OPERATIONS in the rock underlying Shasta Dam have become much more effective since the advent of a device, developed at Grand Coulee Dam, that makes it possible to grout different zones separately and successively. This device has saved a good deal of time and expense because with it grouting operations can be completed in each hole while the rig is set up there, and without waiting for the grout in any zone to set.

The device consists of a series of three leather collars arranged around the lower end of the grout pipe itself, as shown in the accompanying drawing, like the leather diaphragms in an air pump. To hold them in place the pipe is threaded for a length of about 6 in. from the end and a washer



A ¾-in. plug with two pairs of jaw clamps, one open (above) and one closed (below). The clamps are attached to the grout hole casing at the surface as a safeguard.

After being threaded to the casing, the jaw clamp is fastened to the grout pipe.



Sketch showing arrangement of the plug in the drillhole and clamp attaching the grout pipe to casing.

is welded on, as a stop, at the upper end of the threads. The washer diameter is such as to give a clearance of about $\frac{3}{8}$ in. inside the drillhole, so that the device is free to move up and down. Short pieces of tubing, each with a shoulder on its lower end, separate the leather collars. The shoulder backs up each piece of leather and prevents it from reversing. A pair of lock nuts on the lower end of the pipe holds the assembly in place.

When the pressure is applied through the grout pipe, the thrust from below opens up the leather collars causing them to press against the sides of the hole, thus preventing any escape up around the pipe. When the desired amount of grout has been applied near the bottom of the hole, pressure is released and the pipe is withdrawn to any desired position above and the next zone is then grouted. The leather collars readily yield and fall away from the sides of the drillhole when the pressure is released and thus the device can readily be pulled up toward the surface.

Experiments were made with two and with four leather collars but results indicated that three gave the most satisfactory combination. The lowest piece of leather does most of the work; the top collar is practically never marked with grout.

This device has been used for pressures up to 500 lb. in designs developed for use at Grand Coulee Dam. With some minor changes in design, made expressly for operations at Shasta Dam, it was found possible to use the device successfully on grout holes with diameters as small as $1\frac{3}{8}$ in., which is smaller than had been found practicable previously.

Subsurface Survey Provides Water Supply Data

SOURCES of natural water supply which could be tapped quickly in an emergency, and other facts of vital importance to the future development of the municipal area, are being literally "unearthed" by an extensive subsurface survey at Springfield, Mass.

A unit of the Work Projects Administration, which began working in Springfield in January 1941, discovered that beneath the city's streets, down in the stratas of clay, sand and rock, there is a natural supply of water sufficient for an emergency of indefinite duration. This means that should Springfield's normal supply of water, which is obtained from reservoirs, be cut off or seriously damaged, this source could be made available promptly and diverted to the regular mains, or obtained directly through wells.

More than 900 borings have been made so far in all parts of the city and these have brought to light much other valuable data useful in war time as well as in peace. The substrata study by WPA engineers, for example, has provided records for the Army as to the best locations for various operations, building sites and emergency road construction.

The project, sponsored by the Springfield Building Department, was made possible by the WPA, and has been carried on under the direction of George K. Godfrey, chief engineer and supervisor. The original purpose was merely to obtain geological and subsurface data for further reclaiming of land to be used in municipal construction, but the growing threat of war as the project progressed, and the vulnerability of near-surface mains and reservoirs, resulted in its scope being extended. From city engineers, and from contractors and builders, project workers obtained 650 subsurface maps and charts to aid them in their studies.

In addition to the borings, the substrata survey involved the use of Weston College's extremely sensitive traveling seismological observatory. This instrument records the velocity of sound waves sent out from underground blasting stations, through which the location and character of formations beneath the surface are discovered. Twelve small seismo-pickup stations, spaced at 50-ft. intervals along 650 ft. of wires, are connected with the amplifying and recording apparatus in the observatory truck to detect and transmit the waves to the mobile observatory.

Location and depth

Rough determination of location and depth are obtained to within 15 percent of perfection through field tests, and the velocities are corrected to errors of two percent or less in the laboratory. As variation in velocities between the pickup stations is recorded, the presence of rock, dry and water-soaked sand, and a number of other earth formations is disclosed.

Blasts causing the waves are produced from one-pound Nitramon charges, equivalent to the strength of two dynamite sticks, placed 12 ft. underground to keep energy generated by the explosion from being lost above the surface. Two blasts are used consecutively when geological study reveals an uneven bedrock layer. Through this process known as "reversing the profile," the two opposing velocities are recorded and averaged. Nitramon is used since it does not contain nitro-glycerine and is approximately 100 times safer than dynamite.

Reverend Daniel J. Linehan, noted Jesuit seismologist, and Professor Howard A. Meyerhoff, geology professor at Smith College, have worked along with a crew of twelve from the WPA survey unit in making the study.

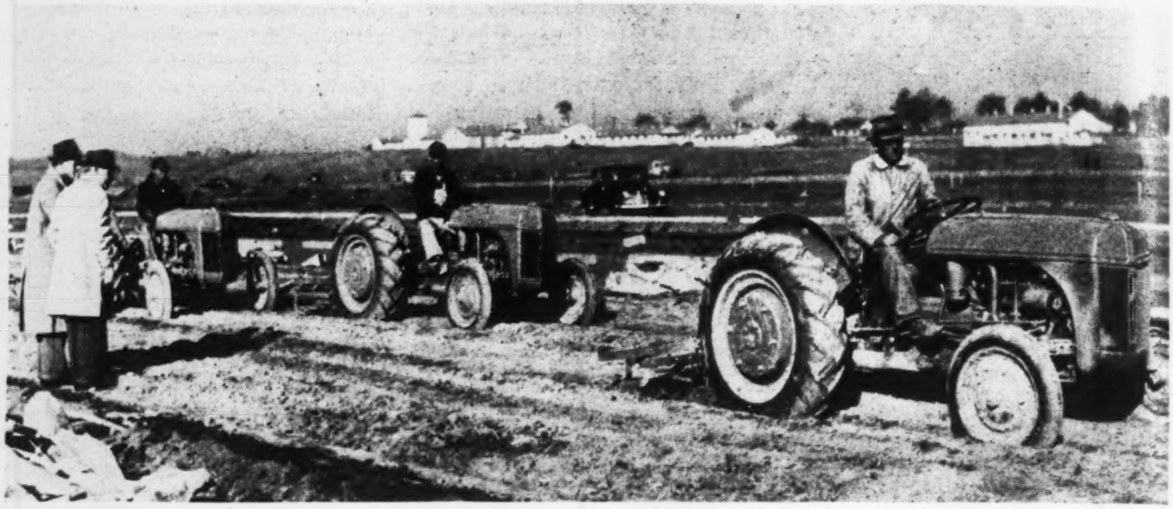


Fig. 1. Wheel tractors draw cultivators and heavy disks to mix cement into the top 6 in. of the soil.

Soil-Cement Base for Airport Runways

William Benjamin West
Engineer, Boston, Mass.

Contents in Brief*—Natural materials have been found satisfactory for soil cement stabilization at the Atlanta, Ga. municipal airport where new runways and taxiways were added at the rate of 6,000 sq.yd. per day. Heavy farm machines, featured by a weeder with a board fastened across the teeth for spreading the dry cement, did most of the work.*

EXTENSION OF RUNWAYS and facilities of the Atlanta municipal airport was made with cement mixed 6 in. into the natural soil for use as runways during the winter. Next summer the cement-treated soil area will serve as a base for 1½ in. of asphalt surfacing. The airport, originally known as Candler Field, had only two runways: an east-west 2,600-ft. strip, and a northwest-southwest 3,500-ft. strip of soil-bound macadam with an asphalt surface. The additions to the airport include the following: extension of the east-west runway by 2,000 ft. to make it 4,600 ft. long; extension to the northwest-southwest runway of 1,000 ft. to make it 4,500 ft. long; a new north-south runway of 4,800 ft.; and a new northeast-southwest runway 3,400 ft. long. All additions are 150 ft. wide, the same width as were the original runways.

The soil-cement process of paving requires mixing the dry cement to a depth of several inches in a pulverized soil in its natural position, ordinarily with heavy farming equipment. The mixture is then wetted to a fixed moisture content, again thoroughly mixed, and consolidated to form a bearing surface. The natural soil at the Atlanta municipal airport consists of 6 percent clay, 22 percent silt and 72 percent sand, which, with the addition of 10 percent by volume of cement, consolidates into a homogeneous mass. About 1,432,000 yd. of material were moved to level the runway and taxiways for the new work.

Soil-cement mixing was done in long strips to keep to a minimum the number of turns it was necessary for the equipment to make. The 150-ft. wide area was divided into 25 or 30-ft. strips and then about a 2,000-ft. length worked at a time. A 6x6-in. timber form was used along the edge of the strip to confine the work to a fixed area and to mark the final surface elevation of the completed lane of soil cement. A trench for this form was dug by turning the blade of a patrol grader to such a position that it almost paralleled the direction of travel and pushed the earth to one side sufficiently to permit laying the timber form. The intermediate strips required no forms, edges of the first-placed surfacing serving this purpose.

Since it is desirable to keep the moisture in the soil uniform, the processing must be carried on continually to prevent the soil from drying out. To get more done with the available equipment, work was started at night. Two sets of double gang plows and one single bottom plow (all having hydraulic controls from the tractor to regulate the depth and to control the elevation of the plows from the ground for turning) were used to turn the soil to a depth of 6 in. A spring-tooth cultivator was then used to scratch the subsoil and bring up lumps. A small gasoline-powered rotary-tiller, controlled through plow handles, served to work the subsoil at corners and other isolated spots in the lanes being processed. A large disk cultivator and two small ones were used to further pulverize the soil.

Early in the morning when the soil was ready, cement in paper bags was placed on the surface of the pulverized 25-ft. wide strip in rows 5 ft. apart with the bags spaced 4 ft. apart in each row. The cement bags were cut by hand shovels and dumped. A farm type spring-tooth weeder with a transverse board set in vertical position and attached to the middle row of the weeder teeth spread the cement uniformly over the plowed surface.

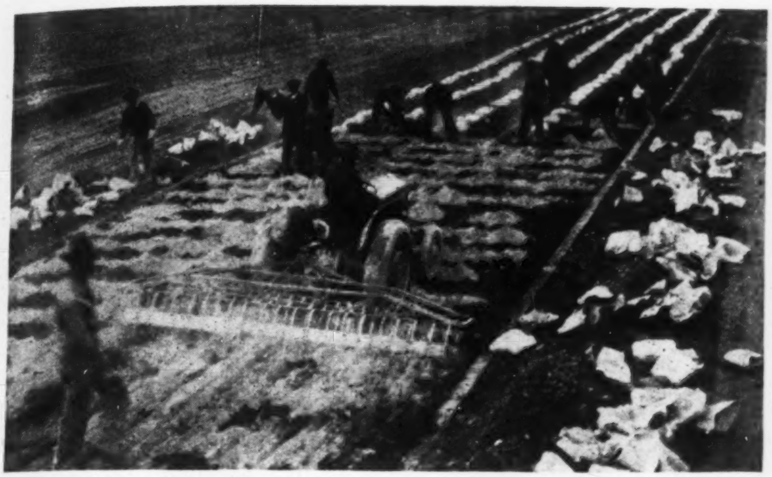


Fig. 2. Cement in paper bags, placed to give 10 percent by volume in the top 6 in. of soil, is cut open and dumped manually, then spread with a spring-tooth farm weeder to a uniform depth over the surface.

The gang plows and the cultivator, including the disk, again were used to mix the cement and soil, after which the moisture content was determined and increased, if necessary, to not over 21 or 22 percent by weight. Water was added by a pressure distributor unit complete with supply tank which was skidded on the platform of a truck and required only the attachment of a spray bar to be ready for sprinkling. The tank had a capacity of 1,500 gal. and the pump was a 200 gpm. high pressure unit that forced water through the 13-ft. long spray bar at a pressure of 80 psi., this much pressure having been found necessary to uniformly and quickly wet the surface. A standpipe, filled from the city's distribution system, was located at one edge of the field and equipped with a rapid discharge valve for filling the water tank. Each truck, operating with a spraying mechanism, was expected to make a round trip, including the discharge of its contents, in fifteen minutes. The same four all-wheel-drive trucks which served at times as water distributors were used to haul cement when the water tank was not needed for spraying.

After the mixing was complete, sheepsfoot rollers were used to pack the soil-cement material from the bottom up, following which a road patrol was used to level off the surface. The surface was loosely scarified before passing a two-ton tandem roller, and a multi-wheel, rubber-tired roller over the surface. The tandem rollers originally were steam-driven but had been converted to gasoline power to provide speedier operation. Incidentally, the engines used for the service were replacement automobile engines. Curing was done with hay spread over the surface and kept wet for seven days to prevent the soil-cement surface from drying out too rapidly.

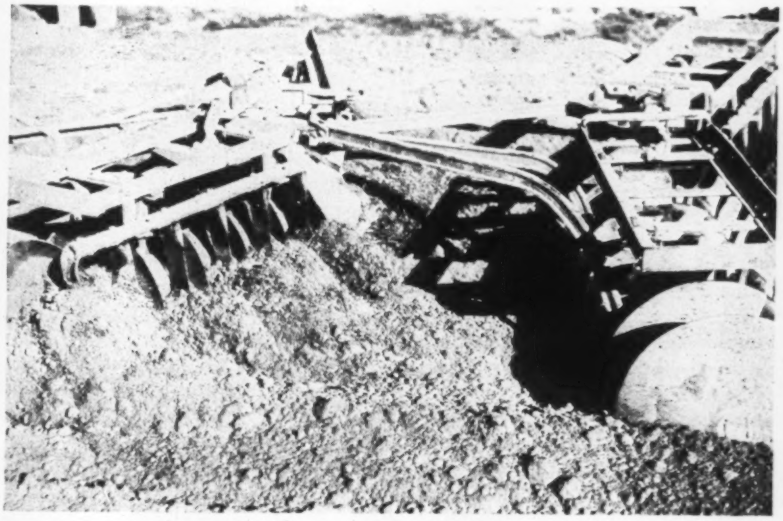


Fig. 3. Close-up of the mixing action of a tandem disk cultivator on the Atlanta municipal airport.

WPA and CAA provide funds

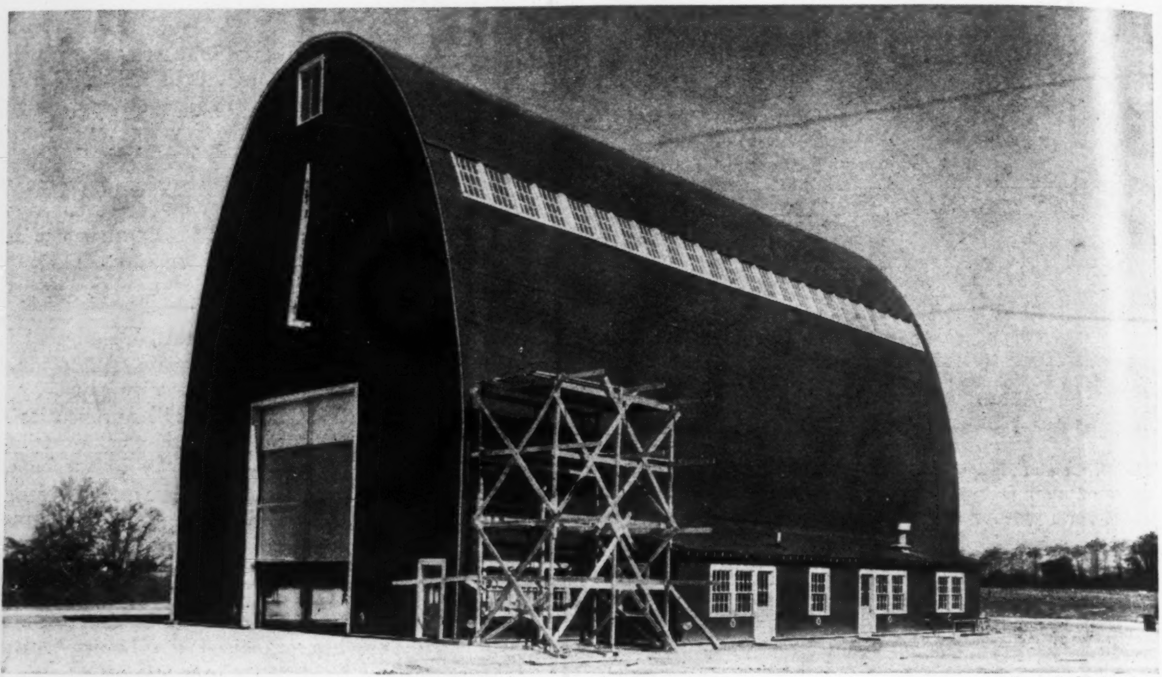
Although the Atlanta airport is a municipal enterprise, funds for the new extension are supplied by the WPA and the Civil Aeronautics Administration, with the work being done through WPA by means of a "rental of equipment" agreement. Under this agreement the contractor supplies operating personnel, fuel and maintenance of equipment and is paid on a production basis. Louis A. Byrne of Dennisport, Mass., has organized the Louis A. Byrne Southern Contracting Co., Inc., in Georgia, to handle this and other projects in the southern states.

Jack Gray is airport manager and engineer for the city of Atlanta. H. Harvie Perkins has served as airport engineer for the Civil Aeronautics Administration and is in general charge of the improvement to the port. Work of the WPA is under the supervision of Don G. Nichols of the division of operations.

Total cost of the project is $700,000 for the improvements which include grading, drainage, lighting, water supply and about 230,000 sq.yd. of 6-in. soil-cement runways. Actual soil-cement mixing operations required 38 days, an average of about 6,000 yd. per day.

Non-Metal Traffic Signs

Shortage of metals is causing cities that need new traffic signs to search for other materials for "stop" and "slow" signals, according to the American Public Works Association. Richmond, Va., is now using wood for its traffic signs, spray-painting them with a preservative before lettering. Police department workshops in Baltimore are making no parking signs of a composition material, and salvaging all metal signs that can be repaired. The composition material is twice as expensive as sheet metal, and also may be limited in supply, Baltimore officials reported.



Kenneth Studio Photo

Fig. 1. Laminated timber arches of 54-ft. span and 66-ft. rise support the roof and sidewalls of this laboratory.

Timber Arches for a Laboratory

Contents in Brief—*Elimination of metal, where possible above the 3-ft. level, resulted in construction of an unusual laboratory building for the Army Signal Corps. Built at Avon, Ky., the structure makes use of laminated timber arches for the principal roof and sidewall framework. The framework between the arch ribs is of timber construction, as is that for the end walls. A special lighting system and non-metallic ducts for the heating system are also employed to eliminate the use of metal.*

To ELIMINATE METAL from the vicinity where delicate instruments are to be tested, seven glued, laminated timber arches of 54-ft. span are used as the roof support for a $36,000 laboratory building at the Avon, Ky., Army Signal Corps depot. The building is 101 ft. long. An 11-ft. wide wood-frame lean-to is used along the greater length of each side, making the overall width about 76 ft.

Rise of the arches, which are placed on 16-ft. centers, is 66 ft. The lower 16 ft. of each arch rib is vertical, while the upper portion forms an elipse. In cross-section each rib is 7½ in. thick (dimension parallel to exterior wall) and 2 ft. wide.

Each arch was fabricated in two 3,600-lb. sections from 13/16-in. thick southern yellow pine. Casein glue was used for this work, which was carried out at Peshtigo, Wis. The sections were shipped to the site on two railroad cars separated by an "idler" car.

Erection procedure

Erection of the arch section was accomplished with the aid of a single steel guyed tower. While lying flat on the ground the two sections of each rib were joined by a timber lashed near the crown. Next, by means of this timber, the entire arch span was raised as a unit. Then to join the two sections permanently at the top plywood splice plates were used, instead of the steel plates ordinarily employed at such joints. At the base the arches are bolted to steel shoes, which in turn are bolted to concrete footings of sufficient size to carry the thrust.

Sidewall and roof framework between the arches is made up of 2x12-in. and 2x4-in. timber members.

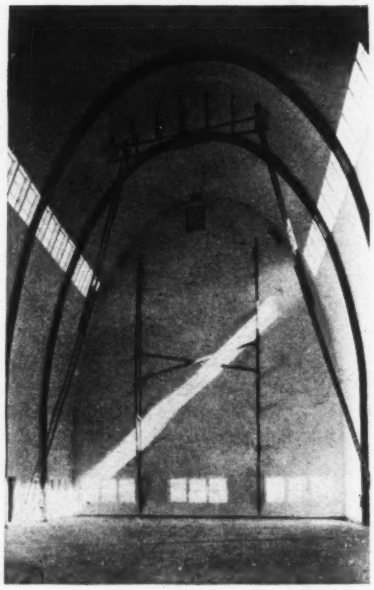


Fig. 2. Along the interior surface of the sidewalls the arches are left exposed while the framework between is covered by furring and insulation board. Note the trusses for bracing the end wall.

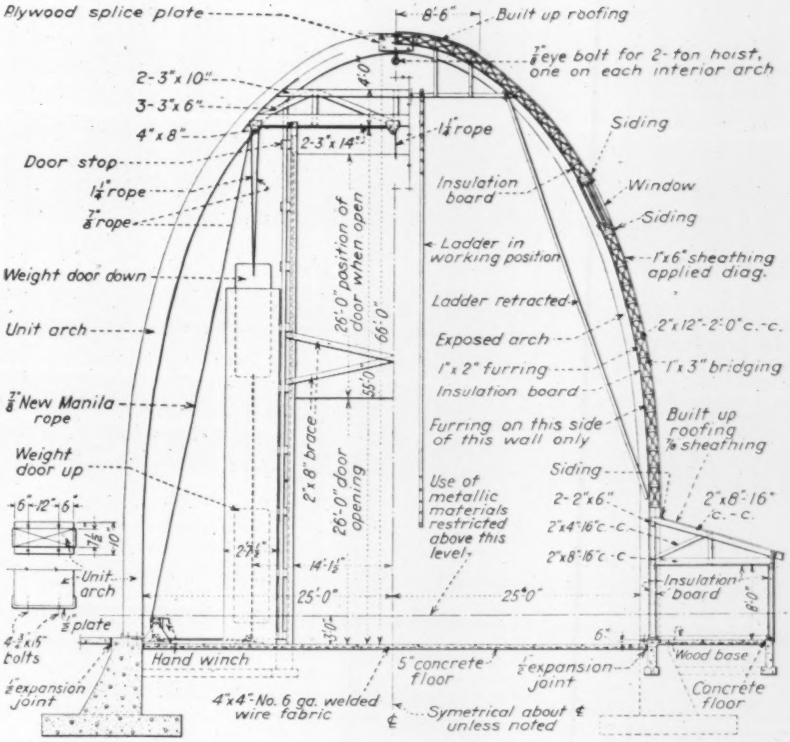

Plywood splice plate
8'-6"
Built up roofing
$\frac{7}{8}$" eye bolt for 2-ton hoist, one on each interior arch
2-3"x10"
3-3"x6"
4"x8"
2-3"x14"
4'-0"
$1\frac{1}{4}$" rope
Door stop
$1\frac{1}{4}$" rope
$\frac{7}{8}$" rope
Siding
Insulation board
Window
Siding
Weight door down
Ladder in working position
1"x6" sheathing applied diag.
26'-0" position of door when open
66'-0"
Ladder retracted
Unit arch
Exposed arch
2"x12"-2'-0" c.-c.
1"x2" furring
1"x3" bridging
55'-0"
Insulation board
$\frac{7}{8}$" New Manila rope
Furring on this side of this wall only
Built up roofing
$\frac{7}{8}$ sheathing
Weight door up
2"x8" brace
26'-0" door opening
Siding
6"-12"-6"
$7\frac{1}{2}$"
10"
Use of metallic materials restricted above this level
2-2"x6"
2"x8"-16" c.-c.
2"x4"-16" c.-c.
2"x8"-16" c.-c.
$2'-7\frac{1}{2}$"
$14'-1\frac{1}{2}$"
Unit arch
25'-0"
25'-0"
Insulation board
8'-0"
$\frac{1}{2}$" plate
3'-0"
6"
$4\frac{3}{4}$"x15" bolts
Hand winch
5" concrete floor
$\frac{1}{2}$" expansion joint
Wood base
$\frac{1}{2}$" expansion joint
4"x4"-No. 6 ga. welded wire fabric
Concrete floor
Symetrical about ℄ unless noted
℄

Fig. 3. Left half of this drawing shows the detail near the end of the building, while right half shows the details of the framing between arches.

Most of the sidewalls and roof is covered by 1x6-in. diagonal sheathing plus roofing paper, but for the topmost part of the roof a built-up roofing is employed. The roof is broken up on each side by a continuous band of windows with wood frames.

Arches exposed on the inside

On the inside the arches are left exposed, but the framework between is covered by 1x12-in. furring and insulation board. The rough side of the latter is exposed.

For each of the end walls a vertical 8x8-in. timber or post is used 10 ft. either side of the center line. Between these two members horizontal 8x8-in. timbers on $6\frac{3}{4}$-ft. centers and vertical 2x8-in. timbers on 2-ft. centers are used. Framework between the posts and the arch legs is much the same, except 6x8-in. horizontal members are used. Also, at each end two vertical stiffening trusses of wood construction, one at each of the 8x8-in. posts, are employed (Fig. 2). The covering for the framework of the end walls is much the same as that for the lower sidewalls.

In one end of the building provision has been made for a few windows, while in the other end a 20-ft. wide by 26-ft. high opening is provided by raising vertically a door of 2-in. tongue and groove planking braced by 2x4-in. and 3x12-in. timbers. Above the door a cathead (Fig. 1) is provided to aid in the loading and unloading of materials. To make for easy movement of the door, which is raised by a hand winch threaded with manila rope, a counterweight is employed to balance much of the door's weight. This counterweight consists of a wooden cradle in which are placed two sizes of concrete blocks, namely, $1\frac{3}{4}$x1x$\frac{1}{2}$-ft. and $1\frac{3}{4}$x$\frac{3}{4}$x$\frac{1}{2}$ ft. Blocks are added or removed until the door may be easily opened but will tend to stay in a closed position.

The building's floor, which was placed directly on the foundation soil, consists of a 5-in. thick concrete slab reinforced with 4x4-in. wire fabric of No. 6 gage.

Wiring for electric lights is placed below the 3-ft. level with the lights themselves hanging from low tripods. This was to eliminate all possible metal in the area where the sensitive instruments were to be tested. In the same way the boiler to heat the building was set at a low level and all heat ducts are of nonmetallic materials.

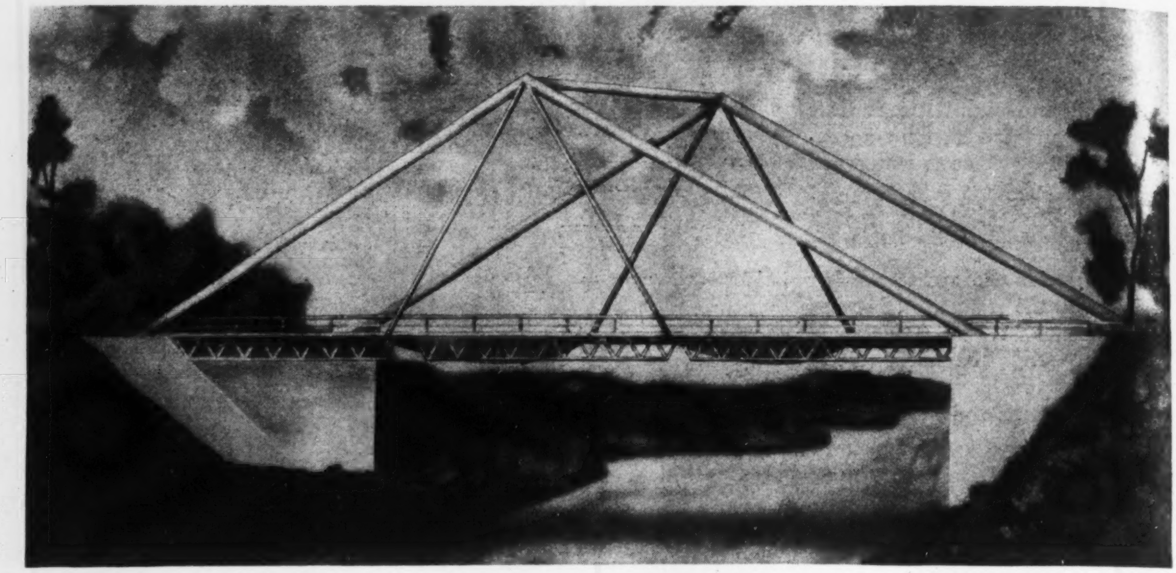
For the War Department, Col. C. H. Menger was in general charge and Lieut. L. G. Schweickart supervised construction. The arches were designed and fabricated by Unit Structures, Inc., Peshtigo, Wis., while Allied Engineers and Architects, Lexington, Ky., with Harry Catching, chief engineer, prepared the plans.

Intestinal Disease Outbreaks in U. S. and Canada

For the third successive year the American Water Works Association committee on methods of water treatment and laboratory control, G. D. Norcom, consulting sanitary engineer of New York, chairman, sent out questionnaires to all state and provincial sanitary engineers in the United States and Canada requesting information on outbreaks of intestinal disease. Although by no means complete, particularly as regards outbreaks which were not water-borne, the reports received showed the number of outbreaks of intestinal diseases reported from all causes totaled 376, according to the committee's report at the association's recent annual convention at Toronto, Ont. In all, 47,776 cases were involved, not including those classed as "sporadic."

Of the 376 total, 48 outbreaks were classified as definitely water-borne and 17 were attributed to public water supplies. Twenty outbreaks were listed as "possibly" water-borne, and 12 of these were attributed to public water supplies. The majority of the outbreaks, namely 183, were classified as "gastro-enteritis" but only 26 of these were definitely water-borne and 9 were suspected of being water-borne. Seven of the former and 8 of the latter involved public water supplies.

Significant is the fact that out of the 35 outbreaks of gastro-enteritis the water was definitely shown to contain coliform organisms in 27 instances. The largest single 1940 outbreak of a water-borne intestinal disease occurred in Rochester, N. Y.



Design for a welded tubular bridge suggested by George T. Horton. Departing radically from conventional concepts it nevertheless adheres to common structural principles and practicable and proven construction methods.

Tubular Members to Save Steel

Harold S. Card
Formed Steel Tube Institute,
New York, N. Y.

Contents in Brief—*Tubes have the most efficient sections for compression and torsional loads, are as efficient for tension loads as rolled sections, and can often be used to resist bending economically. Welding makes tube fabrication and jointing practicable. By thoughtful designing, structures can be built of tubular members at a substantial saving in steel over the use of conventional rolled sections, and the structures may also exhibit an over-all economy, which recommends them for peacetime use.*

BECAUSE steel is a critical material for which there is often no promising substitute, it is worth while to investigate the possibilities of the redesign of structural members so that they will require the least amount of steel, while still serving their intended purpose. One method of accomplishing this may well be found in the substitution of round tube sections for other sections which are not so efficient.

The fact that the round tube section has the same moment of inertia and the same radius of gyration in all directions makes it inherently the most efficient section for torsional and compression loads. For bending loads in a single direction, various rolled sections are more efficient than the round tube, but where bending may occur in all directions or when bending is combined with torsion, the tube section is again superior. For tension loadings there is no advantage either way.

Comparatively little consideration has been given to the structural use of steel tubing. The most important reason for this seems to be that engineers have compared it with rolled sections on a cost per pound basis, and in such a comparison the tube section is at a very great disadvantage. Furthermore, until quite recently there has been no economical method of joining tubes together or connecting tubes to rolled shapes. The development of the fusion-welding process has provided means of making connections that are at once highly efficient and very economical.

The weakness of the cost per pound basis of comparison is that it does not take into account the over-all economies that are possible in fabrication. There is in the first place an important saving in weight. Compression members utilizing the round tube section can save up to 50 percent in weight. Due to their extreme rigidity they can also be fewer in number, thus reducing the number of connections that have to be made. The reduced weight means a considerable reduction in transportation cost, particularly if parts have to be transported over long distances. There is also a saving possible in the supporting structures or foundations due to the reduced load.

With rolled sections it is common practice to provide a greater thickness of metal than the design load requires on account of the possibility of members becoming weakened by corrosion. Round tube members present less surface to corrosion and, when properly sealed at connections, they contain only a dead air space in which corrosion is not active. Correspondingly, since the tube presents the smallest amount of surface, it requires less paint or other protective coating.

There is still another possibility in reducing weight by increasing the allowable working stresses, which are conservatively low for rolled sections. It seems to be a part of the past philosophy of design to make all possible allowances for human errors and inherent weaknesses by using more material to compensate for those weaknesses. The possibility of secondary stresses in properly designed tubular structures is so greatly reduced that it is entirely logical to think in terms of increasing the allowable working stresses; that is, taking the utmost advantage of the inherent structural efficiency by putting confidence in it and saving steel instead of wasting it. It is always possible to develop economical means of stiffening sections locally where the design analysis indicates that such added stiffness is necessary.

It should not be overlooked that the use of tubular members to reduce weight without sacrifice of strength or rigidity is of very great advantage in mobile structures. Such a substitution may well be justified even at a slightly increased cost on the basis of requiring less power for operation.

Redesign of steel structures to utilize tubular members could be expected to follow the pattern of other developments in redesign engineering. Initial cost figures are likely to be disappointing due to lack of familiarity with the material and with fabricating methods. The essential point in redesign should be not to try to copy or to duplicate a former design but to create a new structure utilizing to the highest degree the advantages of the tube from both a structural and a fabricating standpoint.

An unusually good example of such a "new" structure was presented before the last annual meeting of the American Welding Society by George T. Horton president, Chicago Bridge & Iron Co., in the form of a proposed tubular-member bridge for a span of 150 ft. The accompanying artist's sketch shows this unusual structure.

Quoting from Mr. Horton's paper, the 150-ft. span is divided into three panels of 50 ft., the floor of any panel typifying a design suitable for culverts and short spans. A modified king-post truss is used to reduce the number of major joints to a minimum. The chords are 36-in. tubes. The main connections would be made in the shop, so that the field joints would be simple butt joints, easily assembled and easily welded. Additional lateral bracing, if desired, could be provided by knee braces from the top strut to the main chord members or by extending the floorbeams and installing outriggers. The floor of the proposed bridge consists of 100-in. wide plates forming the top chord of stringer trusses spaced 50 in. apart and also the bottom chord of the main trusses. Floorbeams are plate girders.

Effort in the direction of utilizing tubular members is worth while under present conditions because it offers the possibility of saving where saving is needed the most, that is, in ingot capacity. It could be expected that there would result an accumulation of experience in both the design and fabrication of tubular structures which would be of great practical use in the years to follow the present emergency.

Measuring Soil-Sample Volume By Improved Methods

Allen S. Carey
Asst. Geologist, Chief of Soils Laboratory
and
Howard T. Harstad
Junior Engineer, Mud Mountain Dam
U. S. Engineer Department, Seattle District

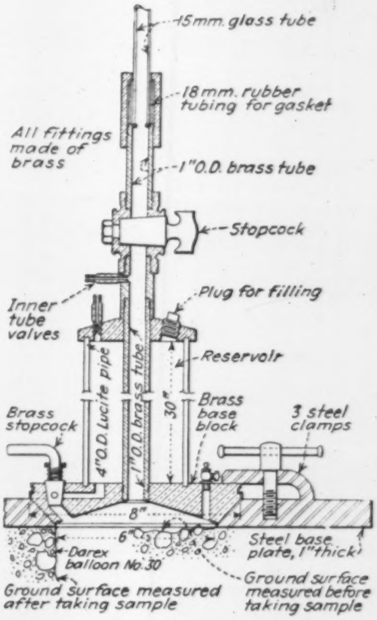
THE SOILS LABORATORY at Mud Mountain Dam was faced at the outset of the work with the necessity of finding a means for accurate determination of unit weight of embankment material considerably coarser than that ordinarily used in earthfill dams. The sand-volume method was known to have several inherent inaccuracies, particularly in coarse material. When checked in the laboratory under careful control, it was found that these inaccuracies may be as much as seven percent. This led to a search for more reliable means with the result that a refinement or improvement of the sand-volume method was developed. Under certain conditions even this improved method is not entirely satisfactory, and a still more accurate means, making use of space measurements by a liquid, was developed and equipment was constructed which has been found to give very accurate results.

Improved sand-volume method

The refinement developed for the sand-volume method requires the use of a steel plate ½ in. thick and 24 in. in dia., with a 6-in. circular hole in the center. Two handles are provided for convenience (other plates with 9 and 12-in. holes, respectively, were also prepared and were used when coarser materials were to be tested).

In testing a compacted portion of the fill, the surface is leveled off, after removing the upper 6 or 8 in., and the ½-in. plate is embedded firmly on this surface so that the metal around the edge of the hole makes a firm contact with the material beneath it. The ground surface exposed within the hole in the plate need not be smooth; that is, rocks may project above the surface or depressions may be left without changing the accuracy of results.

Oven-dried sand is then poured



Details of apparatus used in making hydrovolumetric measurement of a soil sample.

into the hole in the plate and is struck off with a steel straightedge so that the surface of the sand is level with the upper surface of the steel plate. The amount of sand used for filling the hole, as indicated by careful weighing of the calibrated container from which it was poured, is observed and recorded.

The dry sand just placed is then removed together with whatever amount of the material below may be required for the sample. A correction is made in computations for the amount of sand added which is, of course, accurately known. Since the sand is included with the soil sample, it is very important that it be oven dry when used.

After the sample has been taken, the hole is backfilled with the oven-dry sand and is struck off as before to bring the sand surface exactly to the level of the plate surface. The volume of the sample taken from the fill is the difference between the two sand volumes.

This method has the advantage in that the steel plate affords a firm base to which the sand can be struck off for accurate measurement. At the same time, presence of the plates eliminates danger of enlarging the hole by pressure against the sides. Altogether, this method has been found very satisfactory where the sand used for striking off can be kept oven dry and when the weather is dry.

The hydrovolume device

In the vicinity of Mud Mountain Dam the frequency of rain made it quite difficult to keep the sand oven dry for any length of time. Even the moisture absorption from damp atmosphere before the sand was placed in the hole affected final results. To avoid this difficulty, another means of measuring volume was developed in which water instead of dry sand is used as the measuring material. This method makes use of (1) a circular plate with a 6-in. beveled hole in the center and (2) a reservoir of 4-in. outside lucite tubing graduated to 0.001 cu. ft. (capacity 0.16 cu. ft.). With this are appurtenances for attaching a rubber balloon to the base of the reservoir and means for forcing air under pressure into the reservoir chamber. This equipment makes volume measurements within the hole in the plate before and after the soil sample is taken. In other words, the flexible membrane of the balloon fits itself, under pressure, to the shape of the rough surface both before and after the sample is taken. The soil volume is the difference in the two readings.

As in the dry-sand method, the base plate is firmly bedded on a level portion of the compacted fill. Here, again, it is not necessary to smoothly level off the ground exposed within the hole. The only precaution necessary is to see that the plate does not rock and that the edge of the hole in the plate makes firm contact with the soil all around. The method of attaching the rubber balloon to the base plate and the means of controlling the pressure on the water with small air pumps is readily seen by reference to the accompanying drawing.

With the apparatus assembled, the rubber balloon is attached to the base block and the reservoir assembly is firmly clamped to the base plate, the balloon is filled with water, and air pressure is applied until the head of water is raised to about 5 ft. The water head, as indicated by the location of the meniscus, is marked with a rubber band on the glass tube. The base plate clamps are then loosened and the reservoir assembly is removed without disturbing the base plate. The soil sample is then taken from inside of the hole and the reservoir assembly is replaced for the final reading. The difference between initial and final volume is the volume of the sample taken.

The hole in the base plate, which is 6 in. in dia., is ample in all respects for material in which the largest diameters are about 1½ in. For material of larger size, a base plate with a larger opening is better. The cost of making up this apparatus is about $75.

Ridding Reservoirs of Floating Logs

VALUABLE EXPERIENCE in the removal of logs from a reservoir in heavily wooded territory, where the submerged area had not been cleared before flooding, has been acquired on a reservoir owned by the city of Tacoma. When the accumulation of flotsam had increased until it covered about one-quarter the area submerged at high-water stages, a contract for removal of the debris was made with a local logger who elected to dispose of it by burning. An analysis of his difficulties and successes, made by a disinterested engineer, constitutes a record that should be useful elsewhere on similar drift removal problems. The following is a summation of the analysis:

(1) The best method of getting logs out of a reservoir is to work in a season of high water when everything that will float is on the water surface. Prevailing winds usually round up all this material and drive it to one end of the lake. The most economical means of disposal is by burning. When rounded up and all afloat, logs can be handled with a pike pole by one man on a log boom at a rate more than equal to the work of an entire donkey-engine crew at low-water stage attempting to drag logs overland to a burning pile.

(2) The chain conveyor rig ordinarily used for lifting logs from a pond into a sawmill works very well for taking drift out of a reservoir and discharging it over a side-dump platform to a burning pile.

(3) When a burning pile has been started, it is quite possible to feed it and keep it burning fiercely with wet logs just pulled out of the water. The important thing to remember in this connection is that the trestle over which the logs are brought to the fire (assuming that this trestle for reasons of economy will have to be built of wood) must be located a sufficient distance away from the burning pile to avoid undue fire risk. The apron or chute delivering from the trestle to the pile must be made of fireproof material.

Floating drag-saw cuts long logs

On the operations described, a floating drag-saw was used to cut logs that were too long for the side-dump platform. Logs too large to be handled on the chain conveyor were diverted into a boomed enclosure whence they could be pulled together by a donkey engine for burning at low-water stages. With long logs cut in two and those of excessive size diverted, the chain conveyor method was able to dispose of an acre of floating logs during each 8-hr. shift.

An early Hawaiian bridge making use of reinforced-concrete rockers was Kaukonhua Bridge on the Island of Oahu.

Concrete Rockers for Hawaiian Bridges

Lieut. Russell C. Brinker (CEC) USNR

Special Administrative Assistant to the Officer-in-Gharge of Construction
U. S. Naval Air Station, Quonset Point, R. I.

ONE OF THE MOST INTERESTING recent developments in highway bridge construction in Hawaii is the use of reinforced-concrete rockers. Serious corrosion of unprotected steel structures due to the atmosphere's high salt content has led to the practice of building most highway bridges of reinforced concrete. The use of rockers of the same material, therefore, is a natural consequence.

A brief discussion of the use of reinforced-concrete rockers beneath a bowstring bridge in France was given in *ENR*, Aug. 18, 1927, p. 272. The rocker bearings for this structure were 71 in. long, 39 in. wide, 79 in. high, rectangular in shape, and heavily reinforced by double steel spirals interlocked. Each rocker carried a maximum calculated load of 700 long tons.

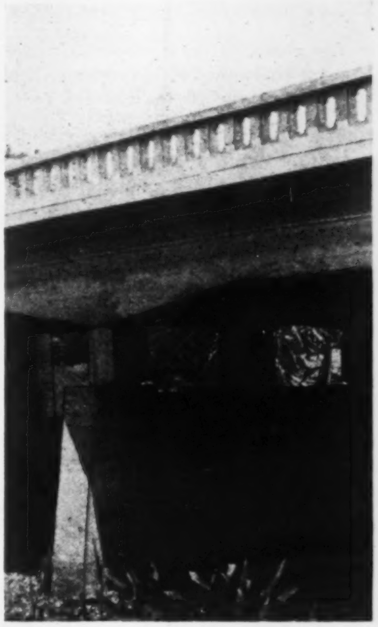
Evolution of Hawaiian design

The first rockers used in Hawaii were similar and had a bearing surface comparable with segmental rollers of a steel roller nest. Later a flat bearing surface extending over about one-third the rocker's width was substituted, a flat slope being used at each side. A ¾-in. thick soft rolled lead plate was also added to provide a cushion at the top and bottom. Movement is almost as free as with the curved rocker, but more bearing area is provided. Standard rockers now have a height of about 1½ times the width.

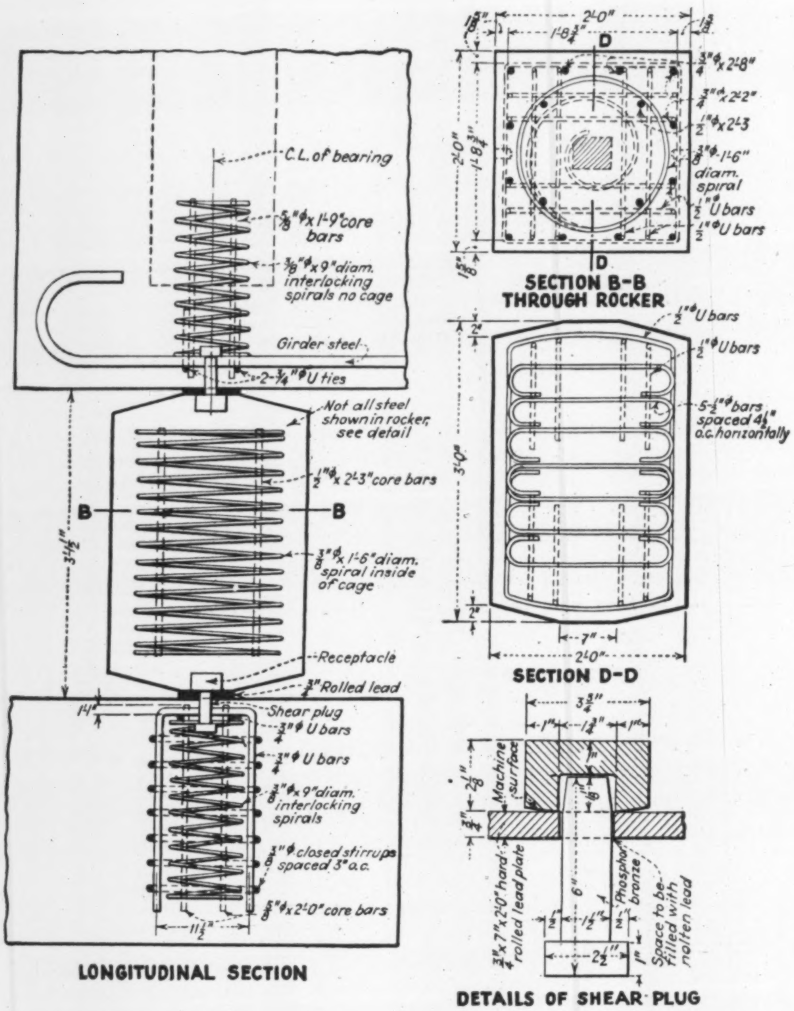
The odd shape of the rocker prohibits the use of ordinary beam-and-column analysis and a suitable design theory has not been evolved. It follows that the proportioning of all rockers is arbitrary. For example, the 18x24x36-in. rockers are typical of the original members. Each unit carried a load of 250,000 lb. Since the largest testing machine available in Hawaii has a capacity of only 300,000 lb., it is impossible to test locally to destruction a full-size rocker.

Arrangement of reinforcing

Details for the present standard 24 x 24 x 36-in. reinforced-concrete rockers used are shown by the accompanying illustrations. Twelve ¾-in. round bars with a minimum 1⅝-in. covering of concrete are spaced 3 in. on centers. Four ½-in. round U-bars (two running each way) are laid across the top and bottom of the rocker with the legs extending 1 ft. toward the middle of the rocker. Four ½-in. round bars comprise the core steel for the 18-in. spiral, which consists of ⅜-in. round bars on a 2-in. pitch. The spiral is finished top and



Standard rockers now built are 24x24 in. in cross-section and 36 in. high. For erection purposes short pieces of galvanized pipe are imbedded on opposite sides of rocker.


C.L. of bearing
5/8"φ x 1'-9" core bars
3/8"φ x 9" diam. interlocking spirals no cage
Girder steel
2-3/4"φ U ties
Not all steel shown in rocker, see detail
1/2"φ x 2'-3" core bars
B
B
3'-4 1/2"
3/8"φ x 1'-6" diam. spiral inside of cage
Receptacle
3/4" Rolled lead
1/4"
Shear plug
3/4"φ U bars
3/4"φ U bars
3/8"φ x 9" diam. interlocking spirals
3/8"φ closed stirrups spaced 3" o.c.
5/8"φ x 2'-0" core bars
11 1/2"
2'-0"
1'-8 3/4"
1 5/8"
D
3/4"φ x 2'-8"
3/4"φ x 2'-2"
1/2"φ x 2'-3
3/8"φ-1'-6" diam. spiral
1/2" U bars
1/2"φ U bars
D
2'-0"
1'-8 3/4"
1/2"φ U bars
1/2"φ U bars
5-1/2"φ bars spaced 4 1/2" o.c. horizontally
2"
3'-0"
2"
7"
2'-0"
3 3/4"
1"
1 3/4"
1"
1"
2 1/8"
1/8"
Machine surface
3/4"
3/4" x 7" x 2'-0" hard-rolled lead plate
Phosphor bronze
Space to be filled with nolten lead
6"
1/2"
1 1/2"
1/2"
2 1/2"
1"

LONGITUDINAL SECTION

SECTION B-B
THROUGH ROCKER

SECTION D-D

DETAILS OF SHEAR PLUG

The standard type rocker is heavily reinforced, as are the superstructure and piers in the area of the rockers. A lead-bearing plate and a phosphor-bronze shear plug are used at the top and bottom of each rocker.

bottom with a hook of decreasing radius. For lifting purposes 1¼-in. dia. galvanized iron pipes, plugged at the inner ends and having the outer ends flush with the surface, are cast into the rocker on opposite sides. The pipes are filled with concrete upon completion of the main structure.

Corrected through bronze shear plugs

A 6-in. long 1½-in. square phosphor-bronze shear plug, incased in a phosphor-bronze receptacle, is centered at the top and bottom of each rocker. The plugs pass through 24x 7x¾-in. hard-rolled lead plates, which fit the flattened 7x24-in. areas of the rockers.

Interlocking 9-in. dia. spirals of ⅜-in. round bars spaced on 7⅜-in. centers are imbedded in the concrete above and below the rocker to assist in dispersing the load in the bridge superstructure and the piers. The pitch of the spirals is 3 in. Steel cages, similar to those in the rocker, also are provided.

Administration

Design and use of reinforced-concrete rockers in Hawaiian bridges are due to the efforts of William R. Bartels, senior highway bridge engineer of the Territorial Department of Public Works, Division of Highways. The writer is indebted to Mr. Bartels and the bridge department for detailed drawings of the rockers accompanying this article.

Opinions and assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

Dampness in Underground Air Raid Shelters

Suggestions for excluding or controlling dampness in underground air raid shelters are given in an article in the British publication "The Surveyor" for December 19, 1941, by F. Sutton Smith. As a basic principle in constructing shelters, Mr. Smith emphasizes that waterproofing should be applied to the external and not to the internal face of walls. Where the amount of water is considerable, the whole of the structure should be incased in asphalt, a layer ¾ in. thick being placed over the foundation slab and carried up the outside of the walls to about 6 in. above ground level. It is important that the floor and wall waterproofing be continuous.

In existing shelters, dampness can be cured by applying asphalt or a waterproof cement to the floors and inside of the walls. Where, however, this method is inadequate, it is probably better to acknowledge the fact and devise means of getting rid of the water. One method is to construct a 2-in. wall inside of the structural wall, leaving a cavity of about 4 in.; a channel formed in the floor of this cavity can then lead the water to a corner sump where it can be removed by an automatic pump.

The most serious question in underground shelters is that relating to dampness caused by condensation, resulting from lack of ventilation and extreme changes of temperature. It is very necessary that an adequate means of permanent ventilation be provided, and where this is by means of pipes care should be taken that the pipes are as short as possible in order to prevent condensation in the vents themselves. Secondly, every door and escape hatch should be open for as many hours of the day as possible.

If the condensation is slight, the walls and ceiling can be treated with cork dust. If it is sereve a more expensive cure should be employed, one method being to cover the walls and ceilings with a system of vertical and horizontal battens on which some form of fiberboard is applied. The battens nearest the wall should be placed vertical in order to prevent the moisture being carried to the fiberboarding, and there should be a cavity as large as possible between the wall and the boarding.

Sewer Squad Organization for Air Raids

***Contents in Brief*—Sewer repair and maintenance forces in Chicago have been organized to perform special emergency functions during aerial bombardment. The regular staff of more than 400, augmented with 400 able-bodied citizens, is believed able to handle 22 simultaneously bombed sewers.**

"A Brick Sewer in State St. has been bombed. The news comes through the police department by radio, and a complaint crew from the first district is dispatched immediately to the scene to find the streets flooded. They call for help and Squad E is ordered to report. Meantime, members of the complaint crew are standing upon a manhole when suddenly it is undermined. They feel the earth tremble and jump to a safer location in the nick of time. As the manhole caves in, water gushes into the street from a broken 36-in. water main."

"Fire and police trucks from nearby stations have arrived. Sewer workmen, after identifying themselves, help form a cordon to keep people back until the water-pipe extension crew can close valves and the gas company gangs stop the flow from a broken gas main. The superintendent of sewers meanwhile has ordered out trucks from a yard 2½ miles away, with lumber for sheeting and bracing, brick and cement for rebuilding sewers, manholes and catch basins, as well as a portable electric light set, pumps, hose connections and a full outfit of tools. The sewer gang clears debris so as to install pumps and unwater the crater and handle the flow of the sewer. An air compressor is set up and air tools are breaking large slabs of concrete in the crater while other workmen are clearing debris or hauling it to temporary dumps in side streets. Trucks are loaded by a crane from the cleared area beside the crater, the muck and debris being removed so that the workmen can get at the sewer and other underground structures. After excavation has progressed sufficiently, the sewer and appurtenances are rebuilt, all local connections repaired, the crater backfilled and the street restored to traffic."

These dramatic excerpts from the Civilian Defense Plan of the Chicago Department of Public Works reveal some details of how that city has organized for the repair and maintenance of its sewer system during aerial bombardment. And by means of a hypothetical "play by play" description of what would happen if sewers were bombed simultaneously at eleven different locations, the Bureau of Sewers shows how it is geared for action.

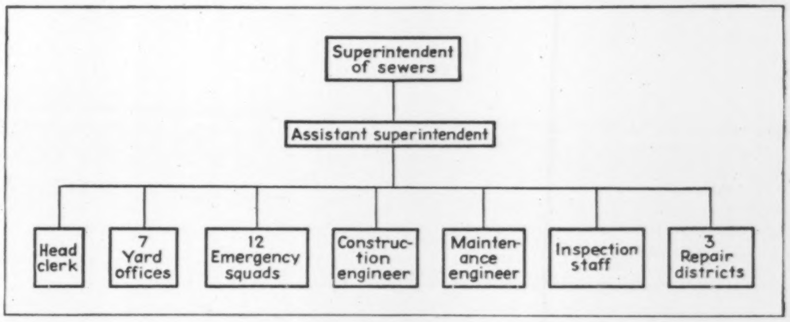
It is the opinion of the Bureau of Sewers, states Superintendent Thomas D. Garry in a report to Oscar E. Hewitt, commissioner of public works, that its regular forces should form the basis of repair and maintenance activities made necessary by raids or sabotage, and that in case of extreme emergency it would be practical to expand these forces with volunteer labor. In that event regular employees would be divided into an assumed number of gangs, which then would be supplemented by volunteers assigned to work with these divided gangs of experienced men from the bureau.

The labor forces of the bureau now are divided among seven sewer-cleaning districts and three sewer-repair districts. For emergency purposes it is planned to combine cleaning gangs with repair gangs to provide a combined total of 378 experienced workmen and foremen. This force will be augmented by assigning 23 mason inspectors as bricklayers and 31 house-drain inspectors as safety wardens. It is estimated that a total of 40 men may be required in a gang to repair a sewer destroyed by bombing. The staff of the bureau, therefore, could send gangs simultaneously to eleven different locations where sewers had been destroyed, each gang in charge of a foreman and an assistant foreman.

However, in a severe bombing raid the sewers might be destroyed at more than eleven locations, the assumption being that such locations might number twenty-two or even more. To expand the force to cover twenty-two locations, the staff would be divided among 22 gangs, giving a nucleus of 19 experienced men for each, and putting each assistant foreman in charge of a new gang. Each gang will be augmented by the addition of 20 or 25 able-bodied citizens who would be selected from previously prepared lists of volunteer employees of sewer contractors or from labor unions whose members are engaged in similar work. Failure to secure experienced labor will mean that 70 or 75 men must be requisitioned from civilian defense volunteers.

Extra tools and services

Following these assumptions of emergency conditions, it is imperative that all supplies and equipment be instantly available. It is stated that the bureau is under-equipped even for normal operation, so that although the eleven crews could be equipped for ordinary handwork, supplies and tools for augmented service are not available nor are there power



Manpower and facilities of the Chicago Bureau of Sewers have been organized in this fashion for aerial bombardment emergencies.

SMALL TOOLS EQUIPMENT FOR A REPAIR GANG

1 Tool cart trailer
1 Wooden ladder
1 Wheelbarrow
1 Mortar box
6 Lanterns
6 Red flags and stands
4 No. 2 shovels
2 4 ft. handle shovels
2 Scoops
1 Digging spade
3 Picks and handles
5 Pails
1 Sounding rod
1 Inlet rod
3 Bull points
3 Sledge hammers
1 Handsaw
1 Claw hammer
1 Hand axe
20 Lb. of nails
1 8 in. sheeting cap
1 Grub axe
1 Maul
1 Hardy hammer
2 Cold chisels
1 One pound hammer
1 Hoe
1 Crow bar
2 Hoisting ropes
1 Tong for bull point
1 75 ft. sewer rod
5 Locks
1 12 ft. chain
1 Hydrant key
4 Bombshell torches
1 Flashlight
1 Drain spade
1 Asphalt cutter
1 Bailing pole
1 Street broom
6 Pair boots
1 Hydrant reducer
1 First-aid kit
1 Kerosene can
3 Pairs goggles
1 Salamander and grate
1 Tamper (20 lb.)
6 Screw jack bracers
25 ft. of fire hose and nozzle
1 Brick hammer
1 Lamping rod
2 2 ft. forms for repair
4 Tin plates for manholes
1 Save-a-life equipment
2 4 ft. Chisel bars

tools for any but isolated major repairs. The department also lacks heavy compressors, cranes or other machinery mounted on auto trucks for emergency transportation.

The value of the present tool inventory is shown to be $384,621. To provide estimated additional equipment, there will be required an outlay of about $410,000.

As a further step, it is suggested that the service vehicles of the sewer bureau be equipped with two-way radio units by which they may be summoned and respond to call. Since it may be impractical to establish a separate broadcast center, this duty could devolve upon the police radio service with the proviso that it be used only in emergencies.

Additional expense of telephone, light, heat, motor fuel, passenger transportation, stationary and office supplies, estimated at $21,500, brings the total estimated expenditure to $449,500.

Damages and duties

One of the features of Chicago's emergency organization and procedure plan is the inclusion of a detailed outline, showing the disposition of repair men and their expected activities during an air raid in which it is assumed that eleven sewers have been bombed. In each case the specific examples provide definite locations and detail the manner by which repairs are to be made.

Although eleven sewer crews will respond to emergency calls, their expansion to 22 crews must be effected during the first six to twelve hours so that continuous work in 12-hour emergency shifts may be underway before crews are exhausted. As trucks and crews leave their yards, second shift crews are ordered to take their place and volunteer labor is notified. By relieving half of the men as soon as clean-up is effected—assumed at six to eight hours—and having men from volunteer lists come in during the first few hours, the half crew sent home can return in eight hours. The other half will work through 14 to 16 hours. From then on the work can be in 12-hour shifts with 22 crews of 20 regular sewer men each, supplemented by 30 to 40 men from volunteer lists.

This would cover the original eleven locations. If expansion to 22 locations becomes necessary, the 22 gangs of 20 men will be divided into 44 gangs of ten men each. The superintendent of sewers then will designate 22 men who have been sub-foremen in regular cleaning gangs to be foremen of the new gangs. The ten regular bureau men in each gang would then include one foreman or assistant foreman, one bricklayer, and eight laborers, who will be supplemented by 30 to 40 men from volunteer lists including, if possible, one or two bricklayers. This plan furnishes 44 gangs working 12-hour shifts at 22 locations and requires from 1,300 to 1,700 volunteer workmen.

It should be noted that this plan requires the use of all the men of the Bureau of Sewers so that all regular work will have to be stopped.

SMALL TOOLS EQUIPMENT FOR CLEANING GANGS

Catch Basin Hand Gang
1 Tool Box
1 Flashlight
3 Red flags and stands
4 Long-handled shovels
1 No. 2 shovel
2 Scoop shovels
2 Post-hole shovels
1 No. 2 shovel
1 Sledge
2 Picks
1 Bull point
1 Mortar hoe
2 Inlet bars
1 Crow bar
1 Hatchet
2 Pails
1 Ladder
1 Bailing pole
1 Hoisting rope
1 Hoop sewer rod
1 Hydrant reducer
2 Hydrant keys
2 Sections 2½ in. hose
1 Street broom
1 First-aid kit

Machine Flushing Gang
1 Flashlight
1 Long-handled shovel
1 No. 2 shovel
1 Post-hole shovel
3 Red flags and stands
1 Sledge complete
2 Picks complete
1 Crow bar
1 Inlet bar
1 Hoop sewer rod
1 Mortar hoe
2 Hydrant reducers
2 Hydrant keys
1 Hoisting rope
1 Pail
1 Ladder
1 Bailing pole
2 Red lanterns
1 Street broom
1 Bull point
1 First-aid kit
1 Lid
1 Grate

Scraping Gang
1 Tool box
1 Flashlight
5 Red flags and stands
1 Long-handled shovel
2 No. 2 shovels
2 Scoop shovels
1 Post-hole shovel
1 No. 2 shovel
1 Sledge
2 Picks
1 Point
1 Mortar hoe
1 Inlet bar
1 Crow bar
1 Hatchet
1 Saw
1 Street broom
1 Safety belt
1 Sewer brace
5 Padlocks
2 Pails
2 Ladders
1 Bailing pole
1 Hoisting rope
1 Hoop sewer rod
2 Scrapers
1 Hydrant key and reducer
2 Pair of boots
3 Split links
1 Brass nozzle
1 Pulley block
1 set Derricks and 200 ft. chain
1 Hempbound cable
1 Section 2½ in. hose
1 First-aid kit
1 Lid and grate

Eductor Gang
1 Flashlight
3 Red flags and stands
1 Long-handled shovel
1 No. 2 shovel
1 Post-hole shovel
2 No. 2 Handle shovel
1 Sledge
2 Picks
1 Bull point
1 Mortar hoe
1 Inlet bar
1 Crow bar
1 Hammer
1 Ladder
1 Hoop sewer rod
2 Hydrant reducers
2 Hydrant keys
1 Street broom
1 First-aid kit
1 Lid
1 Grate
1 20 ft. chain

Complaint Gang
1 Tool box
1 Flashlight
1 Long handle shovel
1 No. 2 shovel
1 Scoop shovel
1 Post-hole shovel
1 No. 2 shovel
3 Red flags and stand
1 Sledge complete
1 Pick complete
1 Crow bar
2 Hoop sewer rod
2 Inlet bars
1 Sounding bar
2 Sec. 2½ in. hose
1 Mortar hoe
1 Hydrant reducer
1 Hydrant key
1 Brass nozzle
1 Pair boots
1 Hoisting rope
2 Pails
1 Ladder
3 Red lanterns
1 Bailing pole
1 Hatchet
1 Saw
1 Street broom
1 First-aid kit
1 Bull point
3 Lids
1 Grate

Strain Meters To Measure Plastic Flow In Shasta Dam

CLUSTERS of Carlson strain meters, ten to each group, are being imbedded in the concrete of Shasta Dam to obtain data for study of plastic flow and other characteristics. In each group of ten meters, nine are mounted on a spider along lines radiating from the center of the spider. The tenth is placed in a 9x18-in. cylinder made of the same concrete as that surrounding the nine meters but it is housed in a protective casing so that it is affected only by those deformations caused by temperature change, moisture loss and growth. This tenth meter is not affected by deformations caused by load on the concrete. In making an elastic analysis of the state of strain at the point covered by the spider, readings on the control meter are used to make the first correction to the total strain indicated on the nine meters concentrically mounted.

Meters installed on two sets of axes

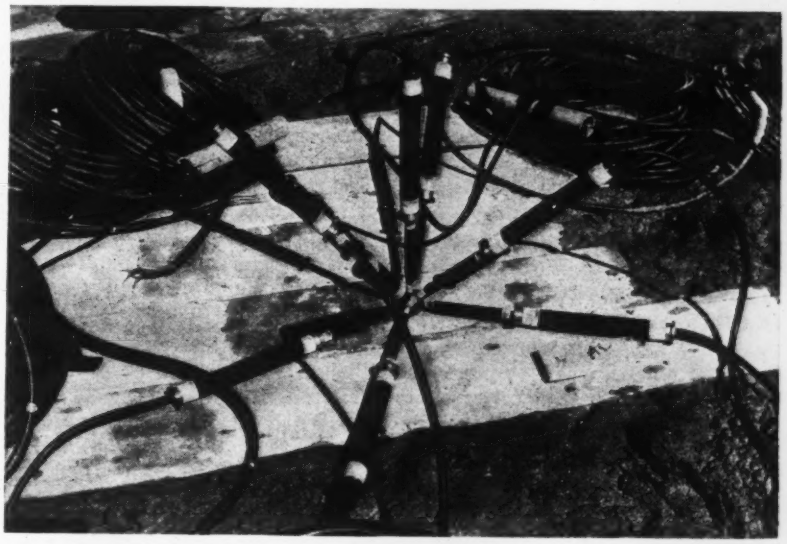
The arrangement of the axes of the meters on the spider is in accord with results of an analysis previously made to determine principal stresses and maximum shears in three dimensions. These nine meters are located on two sets of axes; the first includes a vertical line and two mutually perpendicular horizontal axes and, the second, on which the six other meters are mounted, consist of pairs at 45 deg. to pairs of the first three meters lying in one or another of the three planes defined by the three orthogonal axes. In this way, a further check can be made on the validity of the strain readings by comparing the mass volume change or dilation as measured separately on the two sets.

Inter-meter effects guarded against

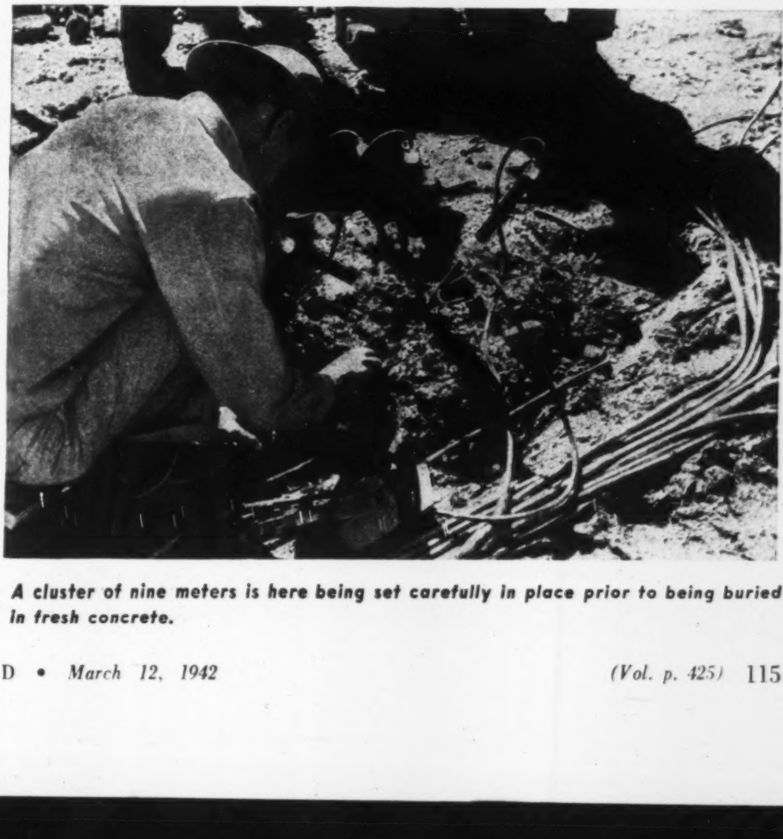
All the strain-meter spiders are duplicates and all are oriented the same when placed in the concrete. Each spider leg consists of a sleeve sliding on rubber stretched over a rod screwed into the central member. In this way deformations in any meter are prevented from passing through the spider and affecting readings on another meter. Bonding of concrete to the spider legs is prevented by a fabric sleeve. Duplicate sets of meters, 5 ft. apart horizontally, are placed in the centers of all high blocks in row 43 of the dam or 100 ft. apart on the center line.

In order to study the effects of plastic flow, meters of the present installation have been put in the concrete of high portions of the dam that will stand about a year before any further concrete is placed. When concreting on this part of the dam is resumed a year hence, another installation will be made in the first lift. This will place the next group of meters only a few feet above those now being set. As concreting is continued, significant differences are expected in the strain readings of the meters in older and newer concrete. Comparisons are expected to show the effect of plastic flow on deformations in concrete.

The spider and the attendant arrangement of the strain meters was developed by engineers of the U. S. Bureau of Reclamation.



Each spider provides a mounting for nine strain meters on spherical radii. This assembly is made and adjusted prior to placement in the concrete nearby.



A cluster of nine meters is here being set carefully in place prior to being buried in fresh concrete.

Adding Third Dimension to Aerial Photos

Vincent V. Colby
U. S. Forest Service
Albuquerque, N. M.

***Contents in Brief**—A means by which a third dimension can be added to aerial photographs so that pictures show terrain in relief without the aid of a stereoscope has been developed by the U. S. Forest Service. The equipment required and the steps to be followed in applying the method, which is known as embossing, are explained, as is construction of relief models from photographic negatives. Directions are also given for application of a new method of bringing a contour map into accurate relief.*

BECAUSE AERIAL PHOTOGRAPHS do not show terrain in relief, except when viewed in pairs through a stereoscope, the Albuquerque, N. M., office of Region 3, U. S. Forest Service, developed an accurate method to treat aerial views which, when rephotographed, make possible pictures showing the desired effect. Known as the embossing method, the procedure was developed after much work and requires only simple equipment. The scheme is to actually raise those points of the photograph that represent higher elevation so that the finished surface elevation at any point on the picture is proportional to the point's actual elevation.

A method also has been developed by the Albuquerque office for using photographic negatives to produce a relief model for exhibit purposes. Still another development brings a contour map into accurate relief by a new and proven method. This procedure consists of constructing a master model and then producing fully legible replicas by a method of embossing.

The method for embossing photographs is as follows: First requisite is a negative of the pictured area. This can vary in size, depending upon available equipment and needs, but for the work to be described 9x9-in. negatives were used. With this negative a positive print is reproduced on a base of sheet lead of predetermined thickness, but not greater than 0.003 in. These sheets, which must be ordered specially made, are 18x30-in. (the largest available), and they cost about $15 a hundred pounds.

To make the positive print a piece of lead sheeting is flattened on a plate glass, chemically cleaned, given a satin finish, and then sprayed with varnishes of a special elasticity, the last coating being white. Then a contact print is made from a negative onto a standard product known as carbon tissue and obtainable in photographic supply houses. After the print has been developed, the emulsion is attached to the white surface of the lead sheeting. A coating of flexible clear varnish is again applied and the sheeting is ready for mounting.

The work of mounting the lead sheet consists of cutting a 12-in. square hole in a heavy cardboard and attaching the sheeting over this hole by means of staples. So prepared, the photograph is ready for embossing and it is possible to emboss terrain faithfully. Details such as steep canyons, precipices and the like can be embossed with remarkable ease and, depending upon the skill of the operator, there is much

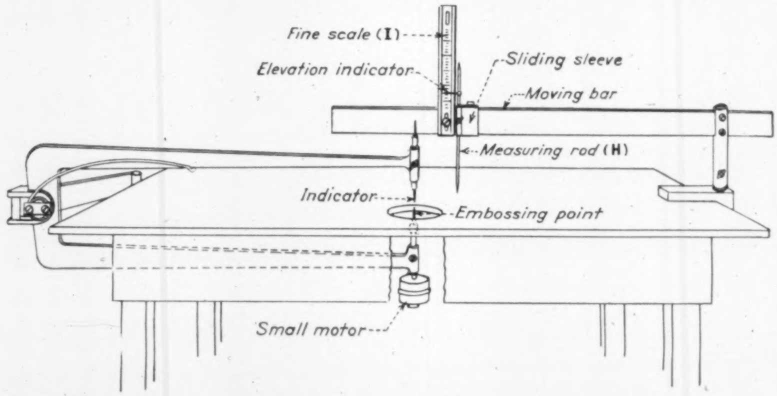


Fig. 1. Major piece of equipment required for embossing photographs is a table equipped as above. In addition, hand tools are used for rough work.

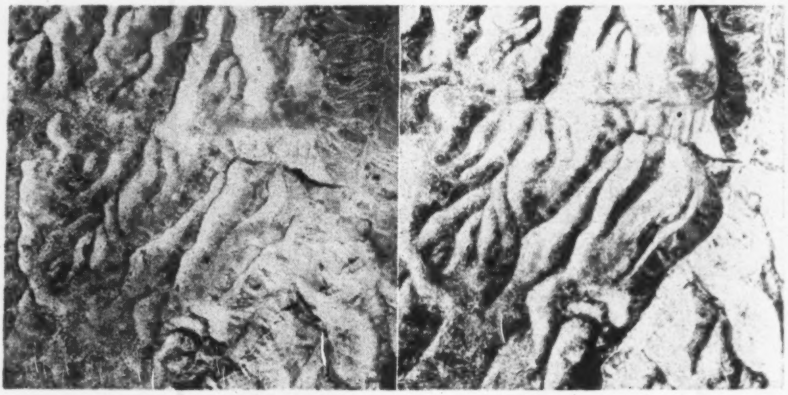
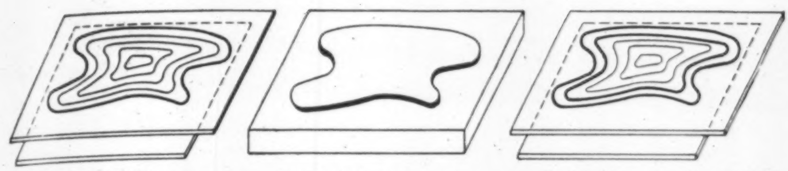


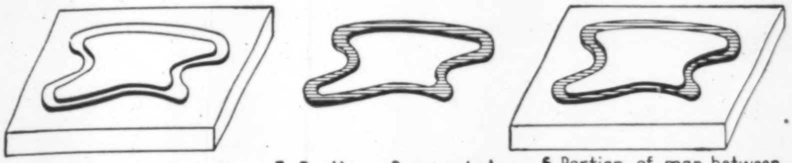
Fig. 2. An original aerial photograph is shown at the left, and on the right is the same picture after having been embossed on the equipment illustrated above.



1. Map mounted on cardboard placed over cardboard of like thickness and lowest contour (heavy line) traced with cutter to cut both cardboards

2. Portion of lower cardboard cut out is now mounted on wooden base

3. Another cardboard of like thickness is slipped under mounted map and cutter traces next lowest contour



4. Piece of cardboard cut out of lowest sheet is mounted over one already on wood base

5. Section of mounted map comprising space between lowest and next higher contour is now completely detached

6. Portion of map between contour lines is fastened with special glue on first cardboard mounted on wood base

Fig. 3. Method of building up a master relief from a contour map printed on cardboard. The steps shown represent the work for one contour interval—thus, there are as many repetitions of the steps as there are contours.

latitude in stretching the soft lead base vertically. While a movement of 1½ in. up or down has been considered sufficient when embossing a 9x9-in. aerial photograph, on larger pictures showing plateaus and mesas a vertical distance of 3 in. has been obtained. The coated lead sheets should not be kept in stock over five days as the emulsion has a tendency to harden and become less workable.

Simple equipment required

Equipment used (Fig. 1) for embossing photographs consists of a table with a very flat top in which there is a 4-in. dia. hole at a convenient distance from the front edge. A forked arm, which may be moved easily, is attached at the left with the upper end of the arm above the table top. This arm is provided with a small vertical rod that is guided by hand and acts as an indicator, in addition to other uses. The lower end of the forked arm is underneath the table top and is provided with a small motor, the shaft of which reciprocates at high speed and to which are attached various points that are used for embossing.

At the right side of the table there is attached a horizontally moving bar, which is provided with a sliding sleeve that in turn carries the elevation indicator. By dropping the measuring rod (designated "H" in Fig. 1) at any location desired, a predetermined vertical distance can be read easily on the fine scale (marked "I" in Fig. 1). The equipment just described is not the sole means of embossing, since manual procedure using various-shaped hand tools are employed intermittently as required for rough work. The equipment also is very important for the control and accurate check of elevations.

When a check with the elevation indicator shows that all elevations are correct, the 9-in. square is photographed to make possible pictures showing the terrain in relief. A comparison between the original photograph and a copy of the picture after embossing is shown by Fig. 2 on opposite page.

Time required for embossing

Depending upon the skill of the operator and detail of terrain, time required to emboss a 9x9-in. aerial photograph is from one to four hours. With elevations already known, and by checking with the stereoscope, a very accurate relief map can be obtained. In addition, with practice, an operator can become efficient in embossing terrain where only the main points are known. A relief map made in this manner will lack accuracy but may, for the purpose of orientation, be useful.

It is also possible to emboss individually a number of aerial photographs of equal or different sizes and then, after each of these has been rephotographed, take the new pictures and assemble them to form a large continuous photograph in relief.

Still another possibility is to make an embossing by first joining various negatives and to make a large print on a prepared lead sheet in much the same manner as with the single negative. Although this shows terrain with fair accuracy, there is difficulty in obtaining negatives of like density. In addition, fitting negatives together is far more elaborate than that of prints, and to emboss with accuracy on such a large field is difficult.

Contour maps in relief

A contour map in relief, which is highly accurate as to elevation interval, but at the same time keeps the lettering and lines fully legible, can be secured by a special method developed by the Region 3 office of the Forest Service at Albuquerque. The procedure is different from older methods in that is does not require tracing or copying part of the map. Here also a negative is required and

Fig. 4. Colby cutter, which is used for cutting the contour map when making master contour map relief model.

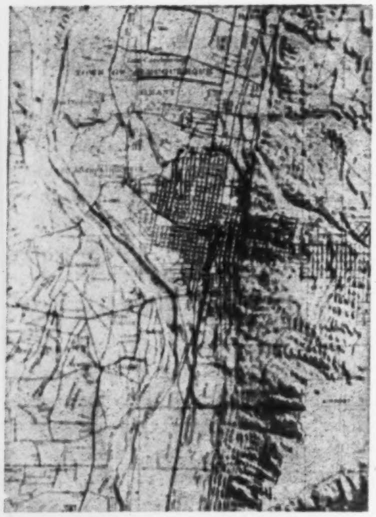


Fig. 5. An embossed contour map showing how names and symbols are clearly retained on the finished product.

two positive prints are made. The first print is on a prepared lead base in the manner described previously for the photographing print, while the second is made on stiff white cardboard in roughly the same manner as applying a print to the lead base. The thickness of the cardboard must correspond to the elevation interval of the contours on the relief map to be constructed. Both prints must be exactly the same size, in fact, hairline register.

A master relief model is made first by using the cardboard upon which the one print was made and plain cardboard sheets of like thickness. The various steps are illustrated in Fig. 3. For cutting along the contour lines as illustrated in Fig. 3, a Colby cutter (Fig. 4) is used. Maps on a small scale with the contours very close together can be cut in this manner, but the fine-cutting chisels required must be made special, since they are not stocked. With the last contour cut out of each cardboard and these cardboard sections mounted on those above the wood base, the master model may be considered complete. This model shows all the printing of the flat contour map, although names and symbols may be parted by cutting.

Using the master model

By use of the master model copies may be produced with all lines, symbols and lettering in more legible continuity. This is accomplished by laying the contour map printed on the lead sheet over the master model in exact register and then carefully depressing the sheet with a soft pad and mallet. In cases of steep depressions, such as precipitous canyons, manual stretching by use of various hand tools is necessary.

Next the lead sheet is loosened so that it simply lays on the model, which is now placed in a fairly close-fitting wooden container with edges somewhat higher than the top of the model. Sandblasting sand is then poured over the lead sheet until the container is full. Next the container cover is screwed on, the box turned upside down, and the bottom removed. The master model is then carefully lifted out, leaving the embossed lead sheet exposed upside down in the sand and without distortion. Plaster of paris is now poured in and when this has set, dried and been trimmed, the now-mounted and embossed sheet is fastened to a baseboard for display.

As many additional replicas as are required can be made in this manner, only a new positive print on a lead sheet and an added supply of plaster of paris being necessary. Time consumed in cutting and building the 16x19-in. master model shown in Fig. 5 was eleven hours, with two men employed, one a cutter and one a builder. Time used in embossing a lead sheet over the master model for making the plaster replica was twenty minutes. Only one man was necessary for this work.

Emergencies at Waterworks Plants

PREPARATIONS for and experiences in emergencies at waterworks are dealt with briefly in a recent issue of *Over the Spillway*, published by the Illinois Department of Public Health. Preparations suggested include: (1) compiling a telephone list of all employees, kept in a convenient place ready for use; (2) making a diagram of the plant and distribution system for help in locating valves and other appurtenances; (3) planning for police cooperation in getting employees to the places where they are needed, and also preventing the public from crowding around areas under repair; and providing emergency connections to other public water supplies, where this is practicable.

How two emergencies were handled

An emergency was created at Moline, Ill., with the blowing out of a 20-in. plug near the waterworks. The plant was put out of service because the pump pits were soon flooded, thus stopping most of the machinery. The operator on duty notified all available employees and shut off the entire distribution system to prevent the emptying of the elevated storage tank. Water from East Moline and Rock Island was turned into the distribution system within an hour or two after the break. Gradually the pump house was drained and the machinery put back into service. The chlorinators were turned on to maximum capacity and, when the Moline supply was again in use, the water flowing into the distribution system had a residual chlorine content of 1.6 ppm., which was maintained through the next week. A complete time schedule was kept of all activities until the entire plant was operating under normal conditions. A. E. Anderson is waterworks superintendent.

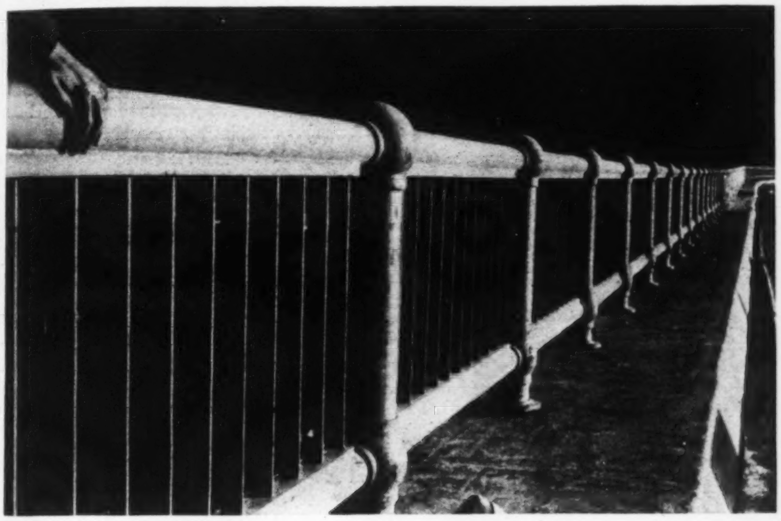
In the case of a main break at Rockford, Ill., a private telephone line to the police department and two unlisted telephones proved of value in notifying employees and contacting other necessary parties. This city employs direct pumping and has no elevated tank. A message was broadcast on the Rockford radio station every eight minutes, explaining the condition, and urging the boiling of water before use. Similar announcements were made at schools and theaters and in the newspapers. After the repairs were made and water again flowed in the distribution system, samples were collected from various points, but on the first day only one of 35 samples showed any contamination. The excellent results shown by these samples are considered due to the absence of cross-connections. The emergency was also minimized by above-ground discharge of all pumps and the availability of emergency crews. H. S. Merz is superintendent of waterworks at Rockford.

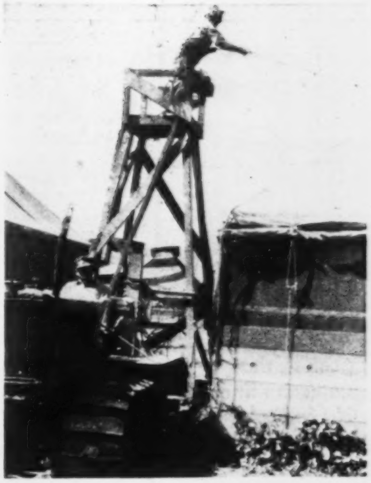
From Field and Office

Working problems and time-saving methods for engineers and contractors

Pit River Bridge Railing

The railing on the roadway deck of the Pit River Bridge, designed to permit the least possible obstruction of view from automobiles, is made up in panels whose vertical members are flat bars with the narrow edge toward the roadway. The posts are pipe sections with threaded castings into which the top and bottom rails project. The bottom of each post projects into a hole left in the concrete sidewalk; after alignment of an assembled length of railing, these holes are filled with grout.





SCAFFOLD EXPEDITES CANTONMENT CONSTRUCTION

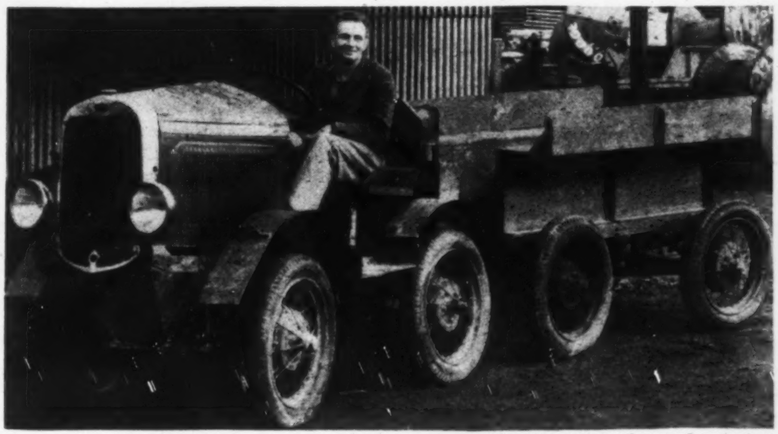
FINISHING UP wire connections to the five-man tents at Camp San Luis, Obispo, Calif., requires that an electrician work some 14 ft. above ground at various points along the tent row. Because deep mud conditions prevailed for several months, the contractor rigged a special sled from which a four-post tower supported a platform at the desired height. A small tractor was detailed to tow the sled. With a crew of three (one man working inside the tents), wire connections were expedited and the work moved ahead rapidly.

Modified Equipment Proves Handy for Tunnel Inspection

For the engineers making the final inspection of the Kensico-Hill View section of the Delaware Aqueduct, the S. A. Healy Co., general contractors, provided the modified Ford car and small trailer illustrated. The latter was designed to carry 8 passengers comfortably and actually did carry 12 without great discomfort.

To permit passage through the access door of a drift at Shaft 23 the auto's chassis was cut down to make the overall height 5 ft. 2 in., the width 4 ft. 4 in., and the length 8 ft. 6 in. The engine was mounted sufficiently high to permit safe passage through 24 in. of water, and the vehicle actually traversed one section where the water stood 30 in. over the invert. The car alone with a little jockeying could be turned around in the 19½-ft. dia. tunnel, driven past the trailer, and coupled to the trailer's other end to reverse the direction of travel.

Headlights of the car provided ample illumination, even for examination of details. The inspection party by means of the car and trailer inspected 19 miles of tunnel in four hours.

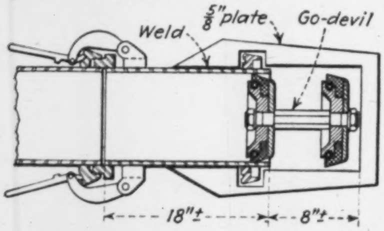


New York Water Supply Board photo

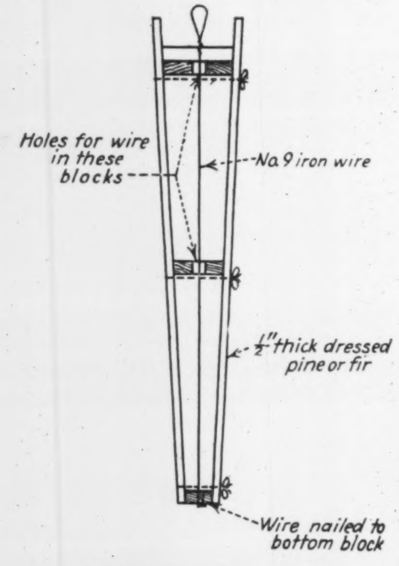
Modified automobile and trailer used successfully in inspection of completed section of Delaware Aqueduct.

Pipeline "Go-Devil" Trap

The device shown below will stop the double-gasketed "go-devil" pushed through a concrete pipeline to clean it at the close of a pour. (The go-devil earned its name from its action and is a dangerous and damaging missile). The open plate is welded over the end of a short section of pipeline equipped with standard connections. It effectively prevents the passage of the go-devil beyond the end of the concrete line and at the same time permits its quick removal.



When high-pressure air is used to push it, the go-devil is apt to be blown from the line with considerable force if extreme care and considerable knowledge is not used to reduce the pressure as the concrete is pushed out of the line. If water is used to push the go-devil, this device stops the flow before water is spilled into the fresh concrete. — CHARLES M. GLINES, *Superintendent, Benjamin Foster Engineering Co., Philadelphia, Pa.*


Holes for wire in these blocks
No. 9 iron wire
$\frac{1}{2}$" thick dressed pine or fir
Wire nailed to bottom block

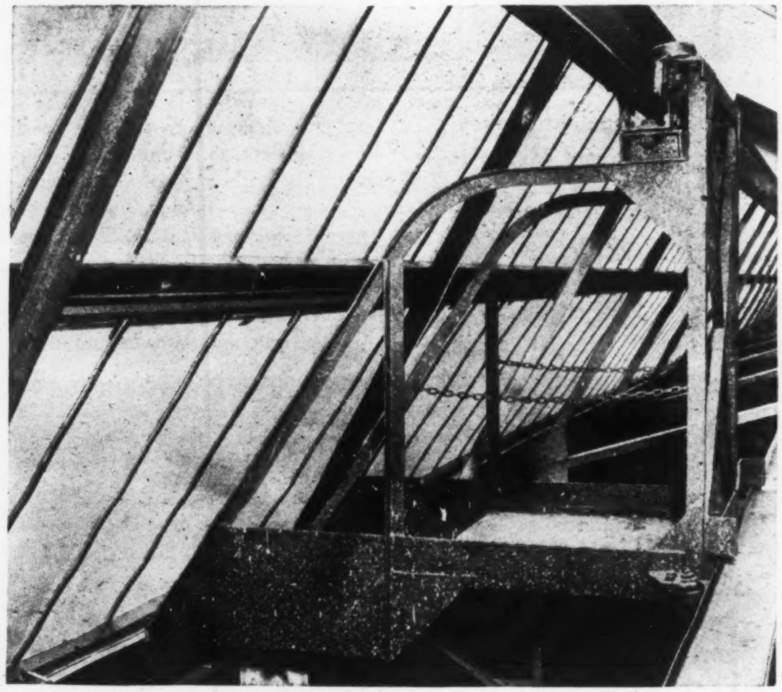
PROVIDING FOUNDATION BOLT HOLES

The box illustrated above greatly facilitates bolt setting, especially in deep machine foundations. As the sides of the box are tied together with light twine and not nailed, they are easily removed by lifting on a small pry inserted in the wire loop. About one inch of taper in three feet on each side of the box has been found sufficient. The lumber should be oiled before the boxes are assembled. Such boxes, which were developed by W. J. Booth, of Stillwater, B. C., when with the Foundation Co. of Canada, were used very successfully on the Canadian Celanese Co.'s plant.

Allis-Chalmers Mfg. Co. photo

TRACTOR EQUIPPED WITH DRIFTER AND COMPRESSSOR SAVES MONEY

On a 10½-mile pipeline project to increase the Hartford, Conn., water supply, Lock Joint Pipe Co. of Collinsville, Conn., is using an 82-hp. tractor equipped with a 315-cfm., two-stage compressor and a drifter on a wagon mounting. Considerable saving has resulted in the use of the tractor with the added attachments.



A CONVENIENT WINDOW WASHER'S CAR

For washing monitor windows of Wright Aeronautical Corp.'s new engine plant at Cincinnati, Ohio, convenient cars of the type illustrated above are provided. Windows run the long way of the 1,030x1,130-ft. building, which is said to be the nation's largest one-story industrial plant, so that each window presents a continuous surface of about 1,100 ft.

"Ten Silver Months . . ."

"EVERY WEAPON *we make today is worth ten that we might produce next year; for this year – 1942 – is the critical year in the existence of the United States."*

This grim challenge was thrown at American industry by Donald Nelson in his first speech as chief of the War Production Board. He was speaking to a group of business paper editors, called together to receive at first hand Mr. Nelson's urgent message to the industries they serve.

"We've wasted the golden months", he declared, "the months in which we could have expanded our steel industry, our chemical industry, our copper industry, and all the others, so that we would have plenty of everything. But we still have ten silver months – the months that remain in 1942–and in them we can do things that we never thought possible."

To that objective Mr. Nelson has dedicated his high talents and boundless energy. And to that task he asks American industry to apply the full measure of its resources and skill.

That challenge should be all that it takes to exact from industry the last ounce of its energies. For by now we all can see that in this war the American way of life is at stake. American industry is the essence of the American way of life. Neither can survive without the other. So, even if it had no better reason, industry must go all out to win this war as a measure of self-preservation. Here self-interest and patriotic duty are synonymous. American industry cannot afford to let America lose this war.

The 1942 job is crucial. If it is well done we have a chance to win. If it is badly done we cannot possibly win. There is the measure of the responsibility that now rests upon the shoulders of industrial management.

It is not just Donald Nelson who asks this of industry. He speaks for the millions of fighting men – on land, at sea, in the air – the world over, whose eyes turn so desperately to the workshops of America. There and there alone can they see the hope of victory.

The people of America are not going to let those men down. They demand of industry every effort and every sacrifice that may be necessary to back them up. On that score, American industry stands, of necessity, on trial before our people. It must come through – or else!

* * *

As industry goes all out to meet this demand, its management asks of those who set its tasks and supervise its performance the utmost possible cooperation. It asks of them specifically an understanding of its problems and a chance to work them out without unnecessary interference. It asks for protection against attack from the rear while it concentrates its energies against the common foe. It asks a truce on economic reforms and social experiments that have nothing to do with winning the war and that are bound to arouse misgiving and mistrust amongst the proprietors of industry. Above all, it asks that it be not made a political scapegoat for every deficiency that is sure to develop in the confusion of a war effort.

This does not mean that industry resents honest criticism or constructive direction. Neither does it mean that it is unwilling to do its best unless it can have its own way in all things. The managers of industry are practical men. They know better than anyone else that unprecedented conditions call for new methods, that they must be open-minded to every criticism sincerely directed toward winning the victory. They know that no one can afford to be smug in the face of a national crisis.

There would be no point to my rehearsing here the pros and cons of such criticisms. Time is too short for that. Only in its performance can industry write a convincing answer to its critics. But as a help toward the achievement of that performance, I should like to clear up, if I can, one prolific source of misunderstanding and mistrust.

I refer to the solicitude of industrial managers as to where their companies may find themselves after the war. *This concern for the future sometimes is misinterpreted to mean that management is blind to the urgency of the present. But it does not mean that. It is a perfectly natural anxiety that must be felt by any responsible management operating under the American enterprise system – which is one of the things we are fighting to preserve.*

Under our system, the managers of industry cannot but feel a sense of responsibility to its owners, not merely for current dividends on their investments but also for the conservation of their properties. That means they must feel some concern over what may happen after the war to a business that now must go all out to help win the war. And their concern is but part of a general concern over what may be the effect of the war on the whole American way of life, preservation of which is our reason for being at war.

To give practical effect to that concern under present conditions is one of the problems of management. It is not an insuperable problem. Competent management will be able to surmount it, I am sure. But the right kind of help from those in authority can make the job a lot easier. And let us note in passing that the problem cannot be written off, as some critics of business seem to think, merely by setting off against it the profits that business can make on war contracts. That misses the whole point.

For a business enterprise is not, as many seem to think, just a "profit-machine." It is not set up and operated by its owners and managers for the sake of this month's or this year's profits, without regard to any other consideration.

The fact is that any worth-while business must operate as a going concern. It consists not only of stockholders and managers, but also of employees, markets, distributors, and dealers. Mostly, I might say, of markets, distributors, and dealers. They are the "reason for being" of any business, the source of its payrolls and its profits.

No competent management wants to scrap such essential elements of its business just for the sake of war-bred profits, however large they might look . . . at the moment. Most of the original reluctance to get into arms production, for which industry has been criticized, was not due to a "greed for profits", as has been charged. Rather did it arise from management's mistrust of "war profits" that can be made only by sacrificing the essential elements of a healthy business.

* * *

But now industry faces a dire national emergency. The survival of our country and all its institutions – including American business–is at stake. So management must shape its course to meet without stint every need of the war *effort. That means it must subordinate to that effort every other concern. To lose the war is to lose all. We must first win the war if we would save anything.*

To the men of management that presents a grave responsibility. It is fair to ask whether government can do anything to help them meet it. One simple thing I think government can and should do. It cannot dissolve all the concerns of management, but it can help substantially.

Government should do all it can to help management conserve those assets of business that will contribute to post-war reconstruction, when that can be done without prejudice to getting on with the war.

Let me explain. Broadly speaking, every business comprises three elements. One is its tangible assets — its factories, machinery, equipment, and materials. Another is its productive capacity — its management, organization, trained working force. A third is its intangible assets — the goodwill, familiarity, acceptance, and recognition that it enjoys amongst its dealers, customers, and prospective customers.

When the nation goes to war government becomes the one dominant customer of a business. Of these three elements, the first two — plant facilities and organization — become of paramount importance to the job in hand. But so far as the government buyer is concerned, the third drops to minor importance.

But that third element cannot be ignored by the managers responsible for that business. For it will be their mainstay when they must rebuild that business after the war, when government has lost all interest in its existence, except as a source of tax revenue. That is why government can help greatly if now, during the war, it recognizes the legitimate concern of management to conserve those assets that will be essential to survival after the war.

Everyone recognizes the obligation of government to demand that the individual business go all out for war production, to forbid the production of goods not essential to wage war and to commandeer those that are, to require that a business sacrifice its markets and disrupt its distribution organization. No one questions the right of government to restrict arbitrarily the amount of earnings that a business may retain as profit from its war activities. In short, no one questions the right of government to become the dominant partner in any business that may be needed to win the war and, as dominant partner, to put the national need above any conflicting interest of the business.

But, as it does all this, government should remember that the survival of that business is staked on the public's knowledge and use of those discontinued or commandeered products, on the stability of that crippled dealer organization, on the ability of the business to maintain its standing in a market-place from which, temporarily, it may be barred.

And government can help management to deal with the exacting task it now faces, if it will do all it can to avert the needless sacrifice of business interests that do not conflict with war needs, if it will but remember that one of these days, that business again will be on its own, gathering up whatever resources it may have left, recreating its markets, rebuilding its distribution channels, reestablishing itself as a going concern . . . and doing all this in a competitive world without benefit of war orders.

The only foundation upon which any business can hope to rebuild when that day comes is its customers' memory of its name and their understanding of its products. Whatever credit may be coming to it for its war effort will not avail it very much if it permits itself to be forgotten. Its chief assets in that day will be the identity, recognition, and acceptance it still enjoys amongst those to whom it must look for business.

That is why so many business men, already going all out on their war jobs, become apprehensive whenever some word or act of a legislator or government official seems to question the validity of their sales, promotion, and advertising activities during the war. For they know that it is by such measures alone that any management can hope to conserve — while its business goes to war — the values it will need when it returns to civilian service.

That is why I ask government to do all it can to allay such uncertainties, to reassure business of its desire to help conserve those intangible assets that mean so much to business security. For that, I believe, will strengthen the hand of management in a big way as it goes all out on the vital job Donald Nelson has staked out for industry.

* * *

He has told us that if we are to make these ten silver months productive enough to make up for the golden months that are gone, industry must do things it never thought it could do. That is dead right. For America now finds itself in a position it never thought it could be in.

All too slowly, but very surely, it is dawning upon us that this is OUR WAR. Moreover it was our war long before we knew it or did much about it. So our job today is not merely to match the current production of our enemies. That is not enough. We must produce also enough to match the surplus of resources they had built up before we got started. We must produce enough not only for our own needs, but also for all the United Nations.

Moreover we must produce all that we need for decisive victory, for anything short of that will mean defeat. If we would save the American way of life, we must destroy once and for all the forces that threaten it. A stalemate would mean but an armed truce and what that might do to the American way of life and to American industry no one dares to guess. Victory must mean *decisive* victory. And this, very definitely is our war.

And just as definitely, this is OUR YEAR. For in this year — 1942 — we must prevent our enemies from achieving an advantage that might put victory forever beyond our reach — despite all our vast resources. It is an appalling fact that victory may slip beyond our grasp — not in 1943 or in 1944 — but during the months just ahead of us.

"Industry's responsibility in all of this is great," says Donald Nelson. "The job will take brains and initiative, but we can do it if we go out with a will."

To Mr. Nelson, that initiative means that industry must lead rather than follow in the march to more intensive use of our machines and our man-power. We dare not wait for new facilities to meet our mounting needs. More and more we must press for more widespread subcontracting and conversion. And he is counting on that initiative, backed by ever more aggressive effort, to avert or to minimize the compulsory measures that now seem imminent.

"We must stop thinking about what we're going to do to the enemy in 1943 and start thinking of what we're going to do to him in March of 1942. We must make today the things we would be making next year . . . if we had the time to spare."

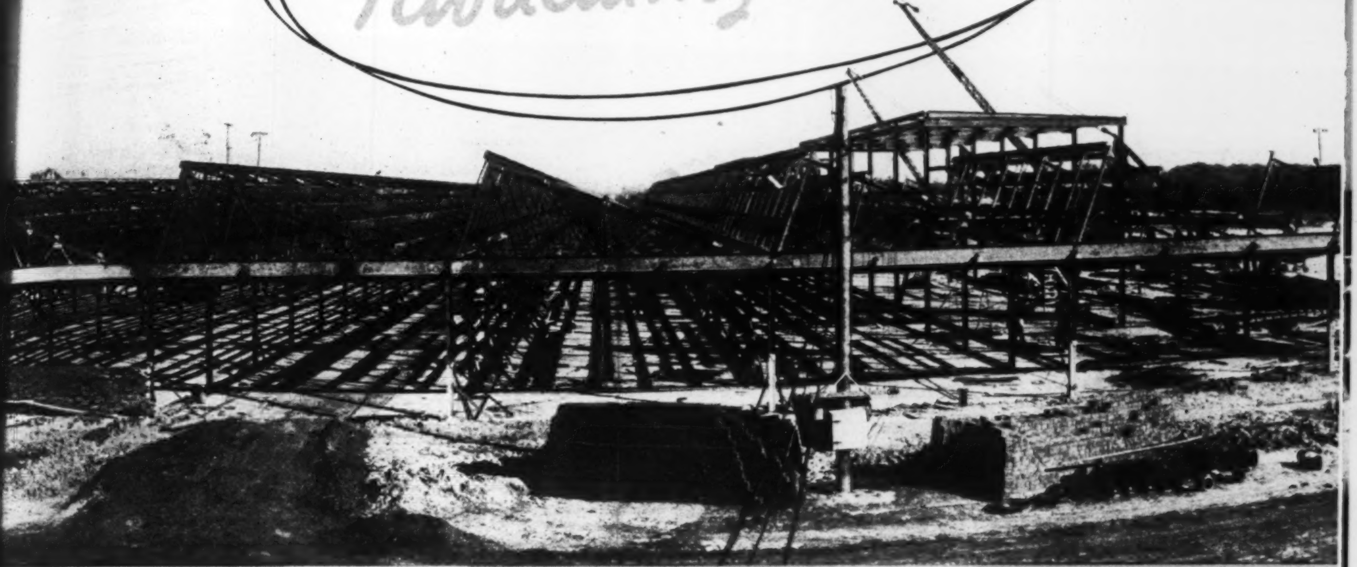
That, says Donald Nelson, is the task of American industry during the next "Ten Silver Months." And to that gigantic task American industry now must bend every ounce of its abundant strength.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

This message is appearing in all McGraw-Hill industrial and business publications, reaching over a million readers.

When the job calls for SPEED and CAPACITY ...use this new *Fabricating Service*



EVERY foot of space — every man and machine must be fully used and closely coordinated if we are to quickly achieve the goal before us. We must expand with speed.

Four V Structural Steel Companies are organized to help speed this program of industrial expansion through their combined resources of time, men and equipment. They have capacity to produce thousands of tons of fabricated structural steel per month.

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Clinton Bridge Works, Clinton, Iowa • Duffin Iron Company, Chicago, Illinois • Gage Structural Steel Co., Chicago, Illinois • Midland Structural Steel Co., Cicero, Illinois

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

SEWER EXTENSIONS, MARYLAND

OWNER: Washington Suburban Sanitary Comn., Hyattsville, Md., and the Defense Public Works Division of the FWA.

PROJECT: Extension of sewer lines to serve Public Buildings Administration housing development near Wheaton, Montgomery County, Md. Involves excavating, refilling, furnishing and laying of 95 ft. of 8-in., 855 ft. of 10-in., and 1,210 ft. of 12-in. vitrified pipe; and 5,100 ft. of 24-in. reinforced concrete pipe. Depths in general range from 6 to 12 ft.

CONDITIONS: Owner to furnish manhole frames, covers and steps; contractor to furnish all other materials and complete work in 90 calendar days. Rail facilities available to within 1½ miles of job site; highway transportation to site. Wage rates are: skilled labor, $1.25 to $2.00 per hr.; semi-skilled, 50c. to $1.25; and common, 85c.

BIDS: Seven bids received February 4, 1942, ranging from the contract low of $37,495 to $59,421.

LIST OF BIDDERS:

1. Leo Butler Co., Silver Spring, Md. (contract)	$37,495
2. James J. Fitzgerald Cont'g. Co., Winchester, Mass.	38,167
3. Intercounty Constr. Co., Hyattsville, Md	38,394
4. J. and F. Tufano Sewer Constr. Corp., Ozone Park, L. I., N. Y	47,976
5. Blackwell Engr. & Constr. Co., Arlington, Va	51,551
6. Peter D'Adamo Constr. Co., Baltimore, Md	52,430
7. DiMarco & Ciccone, Inc., White Plains, N. Y	59,421

		Unit Prices		
Item	Quan.	(1)	(2)	(3)
1. 8-in. vit. pipe, 0-6-ft. deep	70 l. f.	$0.62	$1.00	$0.68
2. 8-in. vitr. pipe, 6-8-ft. deep	10 l. f.	.62	1.50	.73
3. 8-in. vitr. pipe, 8-10-ft. deep	10 l. f.	.70	2.25	.91
4. 8-in. vitr. pipe, 10-12-ft. deep	10 l .f.	.98	3.00	1.13
5. 10-in. vitr. pipe, 6-8-ft. deep	10 l. f.	.62	1.50	.73
6. 10-in. vitr. pipe, 8-10-ft. deep	700 l. f.	.70	2.25	.91
7. 10-in. vitr. pipe, 10-12-ft. deep	160 l. f.	.98	3.00	1.13
8. 12-in. vitr. pipe, 6-8-ft. deep	35 l. f.	.62	1.50	.77
9. 12-in. vitr. pipe, 8-10-ft. deep	1,150 l. f.	.70	2.25	.96
10. 12-in. vitr. pipe, 10-12-ft. deep	40 l. f.	.98	3.00	1.13
11. 24-in. rein. conc. pipe, 6-8-ft. deep	150 l. f.	.67	1.50	.97
12. 24-in. rein. conc. pipe, 8-10-ft. deep	3,330 l. f.	.77	2.25	1.37
13. 24-in. rein. conc. pipe, 10-12-ft. deep	1,640 l. f.	1.08	3.00	1.55
14. 24-in. rein. conc. pipe, 12-14-ft. deep	30 l. f.	1.35	3.75	5.33
15. 24-in. rein. conc. pipe, 14-16-ft. deep	10 l. f.	1.80	4.88	6.00
16. Manholes	190 l. f.	10.80	10.00	18.00
17. 8-in. vit. sew. pipe, furn. and lay	95 l. f.	1.40	.70	.78
18. 10-in. vit. sew. pipe, furn. and lay	855 l. f.	1.57	.93	1.00
19. 12-in. vit. sew. pipe, furn. and lay	1,210 l. f.	1.80	1.13	1.22
20. 24-in. rein. conc. pipe sew., furn. and lay.	5,100 l. f.	4.24	2.60	3.70
21. Class C conc.: encasement	22 c. y.	20.00	11.00	18.00
22. Class D conc.: cradle	6 c. y.	19.00	10.50	18.00
23. Rock excavation	50 c. y.	10.80	8.00	8.00
24. Furn., lay 6-in. underdrains	2,500 l. f.	.68	.55	.70
25. Furn., lay 8-in. underdrains	20 l. f.	.80	.70	.84
26. Earth excav. and refill below subgrade	5 c. y.	2.80	2.50	3.00
27. Gravel excav. and refill below subgrade	150 c. y.	5.40	4.00	7.00
28. Misc. Cl. B conc. masonry	5 c. y.	21.50	14.00	14.90
29. Misc. Cl. C conc. masonry	5 c. y.	20.00	12.00	14.00
30. Misc. Cl. D conc. masonry	5 c. y.	19.00	10.00	14.00
31. Sheeting and shoring	1 M bm	40.00	35.00	68.00
32. Lumber in foundation	1 M bm	47.00	60.00	80.00
33. Misc. and test pit excav. and refill, 0-6-ft	5 c. y.	2.80	1.50	3.00
34. As above, 0-10-ft	5 c. y.	4.20	2.00	3.60
35. As above, 0-10+-ft	5 c. y.	5.60	2.50	4.20

HIGHWAY IMPROVEMENTS NEVADA

OWNER: Nevada Department of Highways, Carson City. R. A. Allen, state highway engineer.

PROJECT: Grading, drainage structures, and gravel surfacing 4.46 miles of Route 60, Section A, between Nelson and point 4½ miles west of Nelson, in Clark County, Nev.

CONDITIONS: Contractor to furnish all materials. Railway transportation facilities available to Las Vegas, and highway to site of work. Wage rates specified as minimums are: skilled labor, $1.375 per hr.; semi-skilled, 75c. to $1.375; and common labor, 70c.

BIDS: Six bids were received November 13, 1941, ranging from the contract low of $87,571 to $108,436.

LIST OF BIDDERS:

1. Silver State Constr. Co., Fallon, Nev. (contract)	$87,571
2. Gibbons & Reed, Salt Lake City, Utah	90,952
3. Dodge Constr. Co., Fallon, Nev	94,643
4. Hoope Constr. Co., Twin Falls, Mont	104,161
5. A. Teichert & Sons, Inc., Sacramento, Calif	106,443
6. Isbell Constr. Co., Reno, Nev.	108,436

		Unit Prices		
Item	Quan.	(1)	(2)	(3)
1. Signs	L.S.	$200.00	$100.00	$250.00
2. Roadway excavation	94,300 c. y.	.52	.52	.60
3. Drainage excavation	1,839 c. y.	.75	.70	.60
4. "V" type ditches	58 sta.	5.00	5.00	7.50
5. Overhaul	189,212 sta. y.	.01	.01	.015
6. Overhaul	2,306 y. mi.	.10	.15	.15
7. Structure excavation	1,014 c. y.	1.50	1.00	1.50
8. Backfill	1,489 c. y.	.75	1.00	.50
9. Subgrade, type "C"	4.46 mi.	100.00	150.00	100.00
10. Water	23 M gal.	5.00	5.00	5.00
11. Gravel surface	29,561 ton	.37	.46	.40
12. Class "D" concrete	1 c. y.	50.00	40.00	45.00
13. Mortar rubble masonry	121 c. y.	20.00	15.00	20.00
14. 18-in. corr. metal pipe, dipped	248 l. f.	2.50	1.95	2.50
15. 24-in. corr. metal pipe, dipped	404 l. f.	3.50	2.90	3.25
16. 30-in. corr. metal pipe, dipped	316 l. f.	5.00	3.70	3.75
17. 36-in. corr. metal pipe, dipped	302 l. f.	6.00	5.90	5.50
18. 30x17-in. corr. met. arch pipe, dipped	116 l. f.	4.00	4.50	4.00
19. 37x21-in. corr. met. arch pipe, dipped	62 l. f.	5.00	5.25	4.75
20. Hand-laid riprap	83 c. y.	10.00	8.00	5.00
21. Grouted hand-laid riprap	208 c. y.	10.00	12.00	7.50
22. Monuments	18 ea.	4.00	4.00	3.50
23. Special signs	L.S.	200.00	150.00	100.00
24. 6x4-ft. laminated culvert	43 l. f.	25.00	25.00	25.00
25. Double 6x4-ft. laminated culvert	119 l. f.	45.00	60.00	45.00
26. 75-in. sectional plate pipe	85 l. f.	25.00	26.00	22.00

HIGHWAY, WASHINGTON

OWNER: Washington State Highway Department, Olympia.

PROJECT: Improvement of 0.505 miles of access road, Primary State Highway No. 1, Purcell Ave., south of Seattle, Wash. Involves clearing and grubbing, all excavation and hauling, cement concrete pavement, drainage structures and removal and replacement of fence.

CONDITIONS: Contractor to furnish all materials and complete work in 60 days. Rail, highway and water transportation facilities available. Wage rates are: skilled labor, $2.00 per hr.; semi-skilled, $1.25; and common, $1.00.

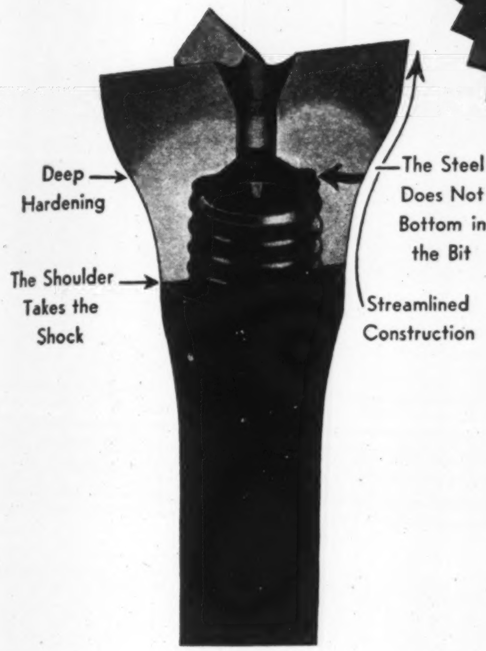
LIST OF BIDDERS: (Opened January 6, 1942.)

1. Fiorito Brothers, Seattle, Wash. (contract)	$58,230
2. Northwest Construction Co., Seattle, Wash	60,654

		Unit Prices	
Item	Quan.	(1)	(2)
1. Clearing and grubbing	L. S.	$4,500.00	$3,600.00
2. Unclassified excav., incl. haul	2,650 c. y.	.50	.60
3. Excav. unsuitable foundn. mat'l, incl. haul	1,700 c. y.	1.50	2.00
4. Structure excavation	1,540 c. y.	1.50	1.65
5. Common trench excav., incl. haul	30 c. y.	1.00	1.50
6. Spec. rdway. borrow, in place, incl. haul	7,760 c. y.	.65	.75
7. Select. rdway. borrow, in place	4,360 c. y.	.90	1.65
8. Screened gravel surf	930 c. y.	2.50	3.15
9. Sand filler, incl. haul	155 c. y.	.65	1.50
10. Water	20 M gal.	2.50	3.00
11. Finishing roadway	38 sta.	10.00	18.00
12. Cement conc. pavement, std	6,427 s. y.	2.90	2.29
13. High early strength pavement	2,516 s. y.	3.00	2.60
14. Dowel bars with rubber caps	1,435 ea.	.27	.28
15. Std. conc. or brick manholes	10 ea.	125.00	150.00
16. Std. concrete catch basins	7 ea.	125.00	75.00
17. Special concrete inlets	8 ea.	50.00	50.00
18. Dipped corrugated iron pipe, 8 in	270 l. f.	2.00	2.00
19. Place conc. or vit. clay sew. pipe, 12-in	722 l. f.	.90	1.25
20. Place conc. or vit. clay sew. pipe, 18-in	1,348 l. f.	1.60	2.25
21. Place conc. or vit. clay sew. pipe, 24-in	564 l. f.	2.50	3.00
22. Std. rein. concrete culv. pipe, 24-in	12 l. f.	3.75	4.50
23. Relay 18-in. concrete pipe	39 l. f.	.75	1.25
24. Relay 24-in. concrete pipe	249 l. f.	2.00	2.00
25. Temporary bridge over pavement	6 ea.	50.00	60.00
26. Gravel backfill in place	211 c. y.	4.00	4.00
27. Remove, replace fence	400 l. f.	.30	1.25

ADVANTAGES OF TIMKEN BITS

Familiar to users for 10 years are strongly emphasized by the War Production Program. Are you enjoying them?


Deep Hardening
The Shoulder Takes the Shock
The Steel Does Not Bottom in the Bit
Streamlined Construction

The *flush* union between the Timken Bit and the steel makes possible a streamlined contour that will by-pass cuttings affording them no ledge behind which to lodge. Result, less stuck steel. The threads of the Timken Bit merely serve to hold the bit on the steel—the hammer blow cannot damage them for the force travels from the steel directly to the shoulder of the bit and from there to the cutting edges. This feature plus definite clearance between the end of the steel's threads and the bottom of the bit assures easy removability.

These basic advantages in Timken Bit design translate themselves into faster drilling at less cost on the job.

There is a Timken Bit for every Rock Drilling Job

The H series; a general purpose bit for contracting, mining and quarrying with light and medium weight drills.

The D series bit for heavy mining and quarrying for use on more powerful drifters and on wagon and tripod drills with larger steel sections.

The M series, an intermediate type to fill the gap between the H and D series bits.

The R series bit used in soft formations such as limestone and sandstone.

The J series bit used in certain types of hard rock formations and ravelled rock.

THE TIMKEN ROLLER BEARING CO., CANTON, O.

TIMKEN
TRADE MARK REG. U. S. PAT. OFF.
ROCK BITS

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

MARCH MATERIAL and labor prices are fairly steady, with the exception of asphalt products. Only minor changes are recorded in cement, crushed stone, crushed slag, iron and steel products, pipe, structural tile, roofing supplies and lumber.

The ceiling set for asplalt products has had the effect of increasing the tank car price of paving asphalt in Detroit by $1.00 per ton, and in Los Angeles by 50c., but decreasing it by $1.00 per ton in Philadelphia. Prices quoted on asphalt in drums in Detroit and Los Angeles are up due to scarcity of drums.

Portland cement is down 10c. per barrel in Baltimore. Crushed stone is off 15c. and crushed slag is 10c. lower in St. Louis. Structural steel shapes are down 17c. per 100-lb. in Kansas City. Vitrified sewer pipe increased in Boston, and concrete sewer pipe climbed in Minneapolis and St. Louis.

Southern pine is up slightly in Cleveland and New York, but off on 2-in. sizes in Kansas City. Douglas fir is $1.50 to $3.50 higher in San Francisco, and up $2.50 to $5.00 on larger sizes in Kansas City.

Carpenters' rate is up 12½c. per hour in Boston, and the plasterers' wage is 25c. per hour higher there. These are the only changes reported in the *ENR* 20-cities' wage list.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT Per bbl., carload lots, including 40c per bbl. for bags, cash discount not deducted			SAND AND GRAVEL Per ton, carload lots			CRUSHED STONE Per ton, carload lots		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE Ready Mixed 1:2:4, 50 c.y. or more, delivered
	Cloth Bags *a*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.73	$2.48	$2.43	$1.75	$1.85	$1.95	$1.75	$1.85	$1.55	$1.65	$7.90
Baltimore	2.36	2.11	1.91	1.75‡	1.75‡	1.25‡	1.75‡	1.75‡	1.75‡	1.75‡	7.25
Birmingham	2.50	2.25	....	1.75	1.75	1.50	1.00	1.00	.90	1.15	5.80
Boston	2.75*b*	2.50*b*	2.30	1.40‡	1.40‡	1.00‡	1.40‡	1.40‡	....	....	7.25*m*
Chicago	2.60	2.35	2.20	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	1.50‡	1.50‡	....
Cincinnati	2.31	2.06	1.81	1.20	1.20	1.10	1.80	1.80	....	....	6.60
Cleveland	2.39	2.14	....	1.60*i*	1.60*i*	1.55*i*	2.05*i*	2.05*i*	1.70*i*	1.70*i*	7.30*i*
Dallas	2.52	2.27	2.07	1.75*p*	2.00*p*	1.25*p*	1.69*p*	1.84*p*	....	....	6.20
Denver	3.08	2.88	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.39	2.14	1.94	1.50	1.60	1.28	1.65	1.65	1.65‡	1.65‡	6.50
Kansas City	2.56	2.31	2.16	1.85	2.30	1.00	1.91	1.91	....	....	7.25*n*
Los Angeles	2.80*v*	2.20*v*	....	1.20	1.20	1.15	1.20*f*	1.20*f*	....	....	6.35
Minneapolis	2.90	2.65	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.85*j*
Montreal	....	1.95*rs*	1.79*rs*	....	....	1.25‡*t*	.85‡*ct*	1.00‡*ct*	....	....	6.45*ls*
New Orleans	2.41	2.16	1.96	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.55‡	2.30‡	....	1.50*de*	1.50*de*	.90*de*	1.70*de*	1.80*de*	....	....	6.75
Philadelphia	2.31	2.07	1.87	1.55‡	1.65‡	1.15‡	1.90	1.90	1.10	1.10	8.20*k*
Pittsburgh	2.44	2.19	1.99	1.40‡	1.40‡	1.70‡	2.25‡	2.25‡	1.50	1.50	8.25
St. Louis	2.80	2.52	....	1.50‡	1.50‡	1.25/1.50‡	1.10*h*	1.10*h*	.75*g*	.75*g*	8.00
San Francisco	....*u*	2.21	1.76	1.36	1.36	1.36	1.46	1.46	....	....	7.55
Seattle	2.95*o*	2.70*o*	....	1.00*o*	1.00*o*	1.00*o*	2.00*o*	2.00*o*	....	....	7.25

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* Plus municipal tax. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off, cash 15 days. *r* 10c. per bbl. off, cash 20 days. *s* 8% sales tax included. *t* 8% sales tax not included. *u* Price withdrawn. *v* 20c. per bbl. discount; 20c. allowed for returnable cloth bag.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn.	$1.80	$1.75
Dallas, Tex. (Inc. 10c. tax)	1.85	1.80	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hannibal, Mo.	1.70	1.65	Norfolk, Va.	1.75	1.70	Universal, Pa.	1.65	1.60
Hudson, N. Y.	1.75	1.70	Northampton, Pa.	1.55	1.50	Waco, Tex. (Plus 10c. tax in Tex.)	1.75	1.70
Independence, Kans.	1.70	1.65	North Birmingham, Ala.	1.70	1.65	Montreal (8% sales tax incl.)	1.68	1.67

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

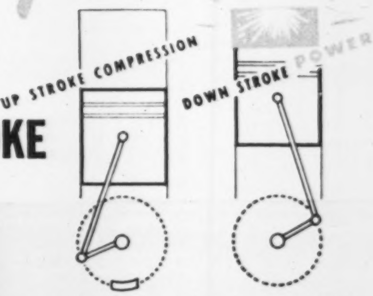
	PAVING BRICKS AND BLOCKS			PAVING ASPHALT Per ton, less than 80 penetration		ASPHALT BINDERS—FLUXES Per gal., 80–300 penetration		CUTBACK ASPHALT Per ton		ROAD OILS Per gal.	ASPHALT EMULSION (Quick-breaking) Per gal.	
	Granite per M. lots of 50,000 4x4x8 in.	Brick per M. 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$39.35	$2.25	$18.40*e*	$24.62*e*	$0.0787*e*	$0.1309*e*	$0.0826*he*	$0.1348*h*	$0.0676*e*	$0.0826	$0.1348
Baltimore	145.00‡	45.00‡	2.90	14.00*	20.00*	.06*	.09*	.065*h**	.115*h**	......	......	......
Birmingham	......	32.00*j*	....	18.20†	23.20†	.0747†	.1047†	.0834*h*†	.1484*h*†	.065†	.09†	.12†
Boston	80.00	50.00	3.75	14.00	20.00	.06	.09	.065*h*	.115*h*	.065	.09‡	.12‡
Chicago	150.00	49.00	2.00*d*	14.50	18.50	13.00*g*	17.00*g*	.065*h*	.11*h*	.055	.10	.13
Cincinnati	112.00	37.50	....	16.00	20.00†	.08	......	11.80	......	.07	......	.085
Cleveland	110.00	38.50	2.25	20.00	25.00	.09	.155	.105*h*	15.00	.07	.11	.15
Dallas	......	36.00	....	13.25	20.30	.06	.103	16.00	24.80	.055	.05/.07	.07/.09
Denver	......	27.50	....	....	.....	......	......	......	......	......	......	......
Detroit	......	37.50	....	15.10*f*	22.60*f*	.0725	.1262	15.10	21.10	.067	.0725	.1262
Kansas City	......	40.00	....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	......	50.00	....	7.00*b*	16.00	7.00*bg*	16.00*bg*	6.00*b*	......	.025	.0525	.1125
Minneapolis	......	......	1.87*d*	21.20	27.70	.....	.126	....	32.64	.....	......	......
Montreal	......	......	....	16.60*k*	24.25*k*	.116*k*	.1485*k*	.115*hk*	.135*hk*	.08*k*	.135*k*	.188*k*
New Orleans	......	......	....	14.00*a*	19.00*a*	.055	.085	.06*h*	.09*h*	......	.078	......
New York	......	......	....	15.00*	21.00*	.06	.09*	.065*h**	.115*h**	......	.0725*	.1225
Philadelphia	125.00	49.50	3.80	14.00	22.00*	.055	.12*	.065*h*	.13*h**	.055	.065	.13*
Pittsburgh	135.00	38.75	....	.....	.....	......	......	......	......	......	......	......
St. Louis	......	37.00	....	15.00	20.00	14.00*g*	20.00*g*	.06*h*	.11*h*	.045	.09	.125
San Francisco	......	70.00	....	9.50	18.00	9.50*g*	18.00*g*	10.00	17.50	9.50*g*	.0525	.1125
Seattle	......	60.00*c*	....	17.90	25.85	......	26.45*g*	12.50	......	9.50*i*	.0575*i*	.1308*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* Delivered to purchaser's warehouse. *c* 3½x4x8½ in. *d* 2½ in. 12-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* 3x3⅝x8½ in. *k* tax included. * December asphalt prices; none later available. †February prices; none later available.

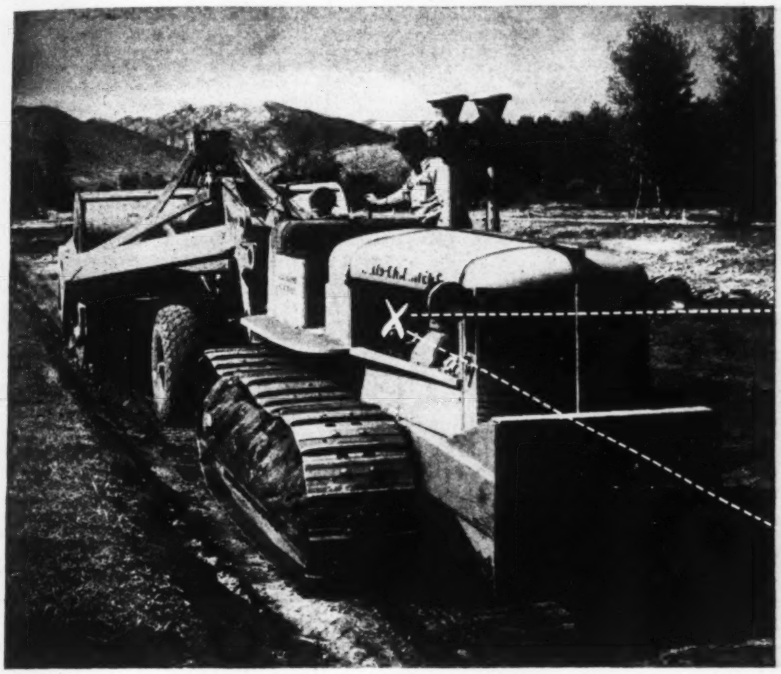
2-CYCLE DIESEL

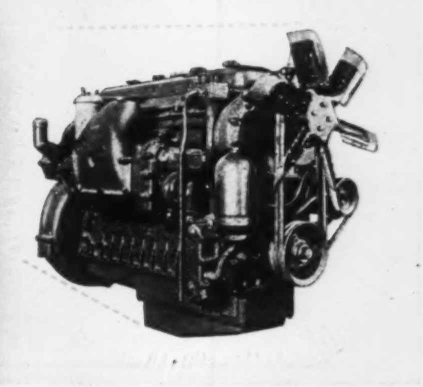
It's Double-hitting power

.. POWER IN EVERY DOWN STROKE



You eliminate exhaust and intake strokes on a 2-cycle Diesel. Fresh air is forced in by a blower and exhaust gases expelled while piston is at the bottom of the stroke. Every up stroke is a compression stroke . . . every down stroke a power stroke.





No wonder the 2-cycle Diesel has so much zip and power and smoothness . . . no wonder it's the modern Diesel power! It develops twice as much power as a 4-cycle Diesel with an equal number of cylinders, and the same bore and stroke, operating at the same crankshaft speed. Thus, a 3-cylinder engine is the equivalent of a 6 . . . a 6, the equivalent of a 12! The result is smoother operation and far greater hanging-on ability—the outfit keeps moving when the going gets tough. There's less gear shifting, too! You can throttle down to half the rated engine speed and still maintain your lugging power . . . also, pick up top traveling speed in a hurry. There's less upkeep, too! Two-cycle smoothness is easier on engine parts, and easy on the equipment. Half the number of cylinders means half the maintenance . . . greater simplicity! Get all the facts on this modern Diesel power. Write for catalogs on 2-cycle Diesel tractors and the Model AD Motor Grader.

ALLIS-CHALMERS
TRACTOR DIVISION · MILWAUKEE · U. S. A.

2-Cycle
THE MODERN DIESEL POWER

• • •

3 SIZES . . . HD-7, HD-10, HD-14
60 TO 132 DRAWBAR HORSEPOWER

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ½-in. billet b	RIVETS ¾-in. structural	WIRE NAILS Base d	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle Bars	Std. Spikes c	Tie Plates	Track Bolts
Birmingham.....	$2.10	$2.15	$3.75	$2.55	.....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.75
Chicago.........	2.10	2.15	3.75	2.55	$2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.75
Pittsburgh.......	2.10	2.15	3.75	2.55	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.75
Buffalo..........	2.10	2.15	.....	.....	2.40	.....	.....	.....	.....	.....	2.15	....
Cleveland........	2.10	2.15	3.75	2.55	.....	.....	.....	.....	.....	.....	....	....
Youngstown.....	.....	2.15	.....	.....	.....	.....	.....	.....	.....	3.00	.....	.....
Detroit..........	.....	2.25‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gulf ports.......	2.45a	2.50a	.....	.....	2.85a	.....	.....	.....	.....	.....	.....	.....
Pacific ports.....	2.75a	2.80a	.....	.....	2.95a	.....	.....	.....	.....	.....	2.30	.....

‡ Delivered. a F.o.b. cars dock. b Rail steel same as billet prices. c Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates, alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. d Add switching charge $18 per c.l.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS* Per 100 lb., ½ in., base price 15 tons or over b New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH Per 100 sq.yd.. carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 s.f.. carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta..........	$2.34	$2.39	$2.39	.02½	.10	$21.06	$23.00	$1.82	$1.35	$0.1719	$3.04
Baltimore........	3.70	2.90	2.75	......	.10	29.00	30.00	1.70	1.27	.1611	3.00
Birmingham.....	2.10a	2.15	2.15	.02½	.10	19.00	21.50	1.80	1.34	.1701	....
Boston...........	3.85	3.51	3.36	$20 C.L.	.10	18.50	29.50	1.76	1.31	.1656	2.70
Chicago..........	2.10a	2.15	2.15	.03	.05	21.50	23.50	1.67	1.25	.1575	2.40
Cincinnati.......	3.68	2.51cd	2.51cd	......	.05	19.50	21.50	1.66	1.25	.1566	....
Cleveland........	2.10a	2.15	2.15	.02½	.10	19.50	21.50	1.66	1.25	.1566	....
Dallas...........	6.00	3.40	3.40	......	.....	24.50	26.50	1.93	1.42	.1827	....
Denver..........	4.35	3.95	3.80	......	.....	26.50	28.50	1.97	1.45	.1863	....
Detroit..........	3.65‡	2.34	2.24	......	.10	22.00	24.00	1.68	1.26	.1584	2.66
Kansas City.....	4.00	2.61cd	2.61cd	.0	.05	19.50	23.50	1.78	1.33	.1683	2.86
Los Angeles......	3.65f	2.25	2.10	.02½	.05	23.00	27.50	1.93	1.42	.1827	3.65
Minneapolis......	3.80‡	2.48c	2.48c	.0	.10	25.00	27.00	1.80	1.34	.1701	2.73d
Montreal........	3.90i	2.65i	2.55i	......	.....	26.00hi	33.00hi	2.58i	3.22i	.264i	....
New Orleans.....	4.40	2.52	2.52	.05	.10	21.50	23.50	1.82	1.35	.1719	2.875
New York.......	3.75	2.76c	2.76c	......	.15	17.50	19.50	1.76	1.32	.1665	2.74
Philadelphia.....	3.65	3.85	....	......	......	19.50	21.50	1.71	1.28	.1611	2.71
Pittsburgh.......	2.10a	2.15	2.15	.02½	.10	23.00	26.50	1.59	1.20	.1503	2.40
St. Louis........	3.69	2.39	2.39	.0	.05	28.00	34.00	1.69	1.27	.1602	2.70
San Francisco....	4.70	2.65	2.50	.02½	.10	21.00	24.50	1.93	1.42	.1827	3.00
Seattle..........	2.75e	2.50e	......	......	......	34.50	38.50	1.93	1.42	.1827	2.95e

‡ Delivered. a Mill prices. b 5–15 tons add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. c 20 tons or over Base. d Mill price plus freight. e F.o.b. dock. f Includes delivery in free delivery zone. g Less than 1 ton, add 25c.; 1 to 5 tons, add 10c. High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills. h List price. i Plus Dominion and Province sales tax.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.a	VITRIFIED SEWER PIPE Per foot, std. 8 in., s.s.	delivered std. 12 in., s.s.	ASTM 24 in.,	C13–35 36 in.,	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered; ASTM 12 in.	C 14–35 24 in.	WROUGHT STEEL PIPE Full standard weight, h 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in.; Lap Weld Black %	Galv. %
Atlanta........	$49 40	$0.26b	$0.468bc	$1.8525	$1.68c	$85.00	$128.00	$0.45	$1.642	48.2	54.2	59.7	51.2
Baltimore......	52.80	.35	.60	2.50	7.10	150.00	200.00	.45	1.60	65.5	57.5	63.0	54.5
Birmingham...	45.00	.275	.495	1.95	5.50	100.00	220.00	.40	1.60	62.2	54.2	59.7	51.2
Boston........	55.00	.32	.62	2.10	....	135.00	....	.65	....	64.1	56.1	61.6	53.1
Chicago.......	53.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.50	67.0	59.0	63.5	55.0
Cincinnati.....	52.70	.231	.4455	1.80	5.125	105.00	170.00	.60	1.70	65.9	57.9	63.4	54.9
Cleveland......	54.24	.203	.3915	1.665	5.125	81.00	125.00	.38	1.60	67.8	59.8	65.3	56.8
Dallas.........	58.20	.305	.549	2.25	5.00	90.00	110.00	.46	1.57	59.9	51.9	57.3	48.3
Denver........	60.60	.24†	.52†	2.16†	....	130.00	240.00	....	....	58.4	50.4	55.7	47.2
Detroit........	54.24	.245	.4725	1.935	4.60	82.50	131.25	.35	1.50	66.3	58.3	63.8	55.3
Kansas City...	55.12	.315	.59	2.20	5.86	140.00	260.00	.45	1.60	62.9	54.9	60.0	51.5
Los Angeles....	55.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	59.6	51.6	57.0	48.6
Minneapolis....	59.00	.275†	.495†	1.98†	5.14†	......	......	.77	1.98	64.2	56.2	60.7	52.2
Montreal.......	60.00	.55	.90	3.68	5.95e	135.00‡l	260.00‡l	.48m	1.92m	....	......	......	....
New Orleans...	51.38	.26	.48	1.69	......	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3
New York.....	52.20	.455	.8775	2.925	7.65	......	......	.50	1.20	64.9	56.8	62.4	53.9i
Philadelphia...	.....	.28	.54	2.30	6.75	120.00	200.00	.45	1.75	56.6	42.8	53.5	39.1
Pittsburgh.....	55.60	.245†	.4725†	1.845†	5.4325	97.80	154.20	.85g	2.00g	68.5i	57.5i	66.0i	54.5
St. Louis......	52.48	.28	.504	2.016	4.50	85.00	220.00	1.10j	1.80k	56.4	42.6	52.5	38.4
San Francisco..	58.00	.3625d	.6525d	2.61	6.52	115.50	192.50	.54	2.75	45.0	31.0	47.0	34.5
Seattle........	55.35	.375	.675	2.70	6.75	84.00	187.50	.45f	1.40f	......	......	......	....

‡ Delivered. † F.o.b. a B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N.J. (base) $49.00. Based on existing freight rates; subject to rate change Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. b Double strength. c List to dealer. d List. e 30-inch. f Less 5% for cash. g Culvert pipe. h Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ½ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. i Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less on butt, 1½ on lap. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld—1 in. and 1¼ in. black 34, galv. 16; 1½ in. black 38, galv. 18½; 2 in. black 37½, galv. 18. Lapweld—2½ in. to 3½ in. black 31½, galv. 14½ in.; 4½ in. to 8 in. black, 32½ galv. 17. j Reinforced; spec. C 76-37. k Reinforced; spec. C 75-37. l Plus sales tax. m Tax included.

170,000 Tons in 4½ Months

TELSMITH PLANT

speeds construction of Army Ordnance Works

★ For the new powder bag-loading plant at the New River Ordnance Works near Radford, Va. 300,000 tons or more crushed aggregate will be required. To supply it the Pendleton Construction Corp. of Wytheville, Va. with the co-operation of Telsmith engineers built a new crushing plant near Dublin, Va. It is Telsmith equipped *throughout!*

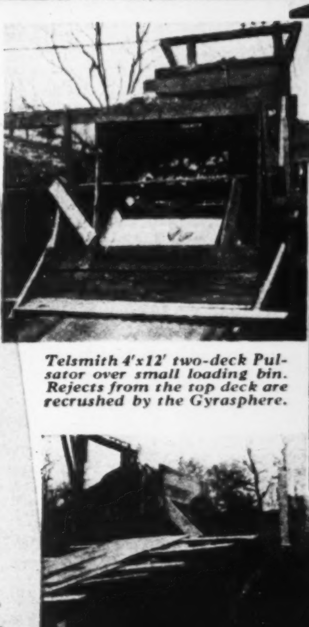
Actual crushing began March 13, 1941, and by the end of July, 170,000 tons of aggregate had been turned out. The capacity naturally varies—from 150 tons to 100 tons per hour—depending upon the sizes produced. Six different sizes of finished products can be made.

The plant amply demonstrates *Telsmith planned production.* Properly co-ordinated and balanced, all units are working smoothly—giving flexibility as to sizes, and dependability as to quantity and quality of product. That's as typically Telsmith as the low cost per ton.

Each of the three Telsmith Crushers (Jaw, Gyrasphere, Roll) is driven by its own Diesel. A Diesel-electric generator supplies current for the individual electric motor drives on the Telsmith Apron Feeder, the two Telsmith screens and the four Telsmith-Barber-Greene Steel Frame Belt Conveyors.

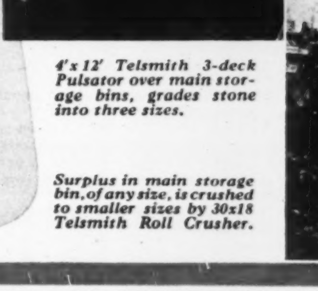
For details on Planned Plant Production by Telsmith—*get Bulletin Q-2.*

Under hopper, 36" x 12' Telsmith Heavy Duty Apron Feeder delivers to 24x36 Telsmith Roller Bearing Jaw Crusher.

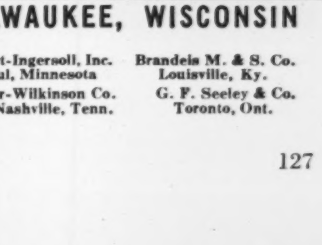


Telsmith 4'x12' two-deck Pulsator over small loading bin. Rejects from the top deck are recrushed by the Gyrasphere.

No. 48 Telsmith Gyrasphere, in closed circuit with 3-deck screen, recrushes the top deck rejects.



4'x12' Telsmith 3-deck Pulsator over main storage bins, grades stone into three sizes.



Surplus in main storage bin, of any size, is crushed to smaller sizes by 30x18 Telsmith Roll Crusher.

SMITH ENGINEERING WORKS, 500 E. CAPITOL DRIVE, MILWAUKEE, WISCONSIN

Cable Addresses: Sengworks, Milwaukee—Concrete, London

Room 1604—50 East 42nd St., New York City
211 W. Wacker Drive, Chicago, Ill.
713 Commercial Trust Bldg., Philadelphia, Pa.
19-21 Charles St., Cambridge, Mass.
Borchert-Ingersoll, Inc., St. Paul, Minnesota
Brandeis M. & S. Co., Louisville, Ky.
Charleston Tractor & Eqpt. Corp., Charleston, W. Va.
Roanoke Trac. & Eqpt. Co., Roanoke, Va.
North Carolina Eqpt. Co., Raleigh and Stateville, N. C.
Wilson-Weesner-Wilkinson Co., Knoxville and Nashville, Tenn.
G. F. Seeley & Co., Toronto, Ont.

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

SHORT LEAF YELLOW PINE AND DOUGLAS FIR
All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face)
All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)

LONG LEAF Y. P.
Merchantable grade up to 20 ft.

PLYWOOD
Rail freight increment (See note for base price)

	Short Leaf Yellow Pine and Douglas Fir									Long Leaf Y. P.		Plywood	
	1x6 S4S	1x8 S4S	2x4 S4S	2x6 S4S	2x8 S4S	2x10 S4S	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	5/8"	3/4"
Atlanta	**$27.00**	**$27.00**	**$26.00**	**$26.00**	**$27.00**	**$28.50**	**$43.00**	......	......	$60.00	$70.00	$17.75	$21.60
Baltimore	**39.00**	**40.00**	**40.00**	**38.00**	**38.00**	**40.00**	**56.00**	......	......	89.00	94.00	17.35g	21.15g
	44.00	*44.50*	*45.00*	*45.00*	*45.00*	*47.00*	*56.00*	*$59.00*	*$59.00*	......	......	......	......
Birmingham	**34.50**	**34.50**	**32.00**	**32.00**	**32.00**	**34.00**	**53.00**	**53.00**	**56.00**	......	......	16.25	19.85
1	37.50	37.50	37.00	37.00	37.00	43.00	65.00	......	......	67.50	70.00	......	......
Boston	38.00[2]	38.00[2]	50.00[3]	50.00	75.00[1]	85.00[1]	95.00[1]	......	......	95.00	105.00	17.35g	21.15g
	38.00	*38.00*	*50.00*	*50.00*	*50.00*	*50.00*	*75.00*	*75.00*	*75.00*	......	......	......	...
Chicago	**43.00**	**43.00**	**43.00**	**42.00**	**44.00**	**46.00**	**53.00**	......	......	90.00	100.00	13.80	16.80
	45.00	*45.00*	*45.00*	*44.00*	*46.00*	*48.00*	*50.00*	*55.00*	*55.00*	......	......	......	....
Cincinnati	**41.00**	**42.50**	**39.00**	**40.50**	**42.00**	**43.00**	**53.00**	......	......	65.00	68.00	16.25	19.85
	......	......	......	......	......	......	*55.50*	*55.50*	*55.50*	......	......	......	....
Cleveland	**42.50**	**42.50**	**41.50**	**43.50**	**45.00**	**48.00**	**53.00**	53.00	53.00	90.00	90.00	16.70	20.40
Dallas e	**39.50**	**40.50**	**39.50**	**38.00**	**38.50**	**39.50**	**53.00**	**53.00**	**53.00**	78.00	83.00	13.90	16.95
Denver ‡	54.00[4]	52.00[4]	55.00[4]	55.00[4]	55.00[4]	56.00[4]	59.00[4]	*78.00*	*79.00*	......	......	9.90	12.05
Detroit	**46.00**	**46.00**	**46.00**	**46.00**	**46.00**	**48.00**	**53.00**	......	......	53.00	61.50	16.25	19.85
	......	......	......	......	......	*51.50*	*54.00*	*60.00*	*60.00*	......	......	......	......
Kansas City	**42.50**	**45.00**	**42.00**	**42.00**	**42.00**	**45.00**	**57.50**	......	......	70.00	75.00	12.25	14.95
	47.50	*47.50*	*47.50*	*47.50*	*47.50*	*50.00*	*57.50*	*75.00*	*75.00*	......	......	......	......
Los Angeles a	*55.00*	*55.00*	*53.00*	*53.00*	*51.00*	*51.00*	*57.00*	*65.00*	*56.00*	......	......	9.35gh	11.35gh
Minneapolis ‡b	48.00[6]	48.00[6]	......	......	......	......	......	......	......	......	......	12.05	14.70
‡	*52.00*	*52.00*	*52.00*	*51.00*	*51.00*	*52.00*	*58.00*	*60.00*	*60.00*	......	......	......	......
Montreal †[7]	*43.00*	*46.00*	*42.00*	*45.00*	*47.00*	*54.00*	......	......	......	**155.00**	**165.00**	......	......
	42.25	*42.25*	*42.00*	*44.00*	*44.00*	*45.75*	*50.25*	*50.25*	*50.25*	......	......	......	......
New Orleans	**31.50**	**31.50**	**33.75**	**31.75**	**34.00**	**35.00**	**48.00**	......	......	69.00	69.00	13.90	16.95
	31.00	*31.00*	*33.00*	*31.00*	*34.00*	*32.00*	*33.00*	......	......	......	......	......	......
New York ‡	**46.00**	**47.00**	**46.00**	**47.00**	**48.00**	**49.00**	**59.00**	......	......	115.00f	125.00f	17.35g	21.15g
‡	......	......	*62.00*	*62.00*	*62.00*	*62.00*	*65.00*	*67.50*	*67.50*	......	......	......	......
Philadelphia	**37.00**	**38.00**	**37.00**	**37.00**	**38.00**	**40.00**	**42.00**	......	......	65.00	70.00	17.35g	21.15g
	47.00	*47.00*	*47.00*	*47.00*	*45.50*	*46.25*	*56.00*	*56.00*	*56.00*	......	......	......	......
Pittsburgh	**50.80**	**53.20**	**62.75**	**55.00**	**60.85**	**62.50**	**76.25**	......	......	......	......	17.00	20.70
	69.20	*68.10*	*66.10*	*65.30*	*65.20*	*65.65*	*88.75*	*88.75*	*88.75*	......	......	......	......
St. Louis ‡c	**45.00**	**46.50**	**44.50**	**42.50**	**43.50**	**45.00**	**59.00**	*67.50*	*67.50*	78.00	66.00	13.90	16.95
San Francisco d	*35.50*	*35.50*	*38.00*	*38.00*	*37.50*	*37.50*	*43.00*	*43.00*	*43.00*	......	......	7.30g	8.90g
Seattle	*35.00*	*35.00*	*35.00*	*35.00*	*35.00*	*35.00*	*40.00*	*40.00*	*40.00*	......	......	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [6] Western Pine, No. 3 Common. [7] Spruce. [8]Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* F.o.b. cars San Francisco freight rate. *e* 10% discount taken off. *f* Up to 18 ft. † Plus sales tax.

Note: Special concrete form grade Fir Plywood, 4′ by 8′ panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface Seattle base price on 5/8″, $86.50; on 3/4″, $95.30; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M. *g* Lower rate by water shipment. *h* 50,000lb. minimum.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS Discounts from jobbers list, Aug. 15, 1938 Single or Double Thickness		EXPLOSIVES Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*
	A quality	B quality	
Atlanta	75%	75%	$0.15
Baltimore	79%	80%	.15
Birmingham	76%	76%	.105
Boston	77%	78%	.15
Chicago	79%	79%	.15
Cincinnati	77%	77%	.15
Cleveland	77%	77%	.19
Dallas	78%	78%	.1625
Denver	76%	76%	.155e
Detroit	77–10%	77–10%	.15
Kansas City	76–10%	76–10%	.155
Los Angeles	86%d	88%d	.1575
Minneapolis	76%	76%	.155
Montreal	40–5%‡	47%‡	.1475†
New Orleans	70%	75%	.16
New York	81%	82%	.22f
Philadelphia	78%	79%	.15
Pittsburgh	79%	79%	.1225
St. Louis	76–10%	76–10%	.155
San Francisco	78%	80%	.155
Seattle	75%	76%	.1575†

Price of 60% Ammonia Gelatin is $0.01 per lb. higher than 40%

a Disc. from list Sept. 1939. *b* Also less 6% tax exemption. *d* Discount from jobbers' list Sept. 15, 1928. ‡ Plus sales tax.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb.
(except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.105	$0.13	$0.15
W. of Miss. to Rocky Mtn. States, Fla. and Maine	.11 –.1175	.135 –.1475	.155 –.1675
Rocky Mtn. States	.11 –.1225	.135 –.1525‡	.155 –.1725‡
Pacific N. W. States	.1075–.12	.1375–.15	.1575–.17
Pacific S. W. States	.1050–.1125	.135 –.1425	.155 –.1625

‡F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES—F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf Barge	Short Leaf Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.23	$0.26
12 in.— 2 ft. from butt	6 in.	50 to 59 ft.	.26	.28
12 in.— 2 ft. from butt	6 in.	60 to 69 ft.	.27	.29
14 in.— 2 ft. from butt	6 in.	50 to 69 ft.	.28	.29
14 in.— 2 ft. from butt	6 in.	70 to 79 ft.	.31	.33
14 in.— 2 ft. from butt	5 in.	80 to 85 ft.	.40	.44
14 in.— 2 ft. from butt	5 in.	85 to 89 ft.	.45	.482

RAILWAY TIES

Prices f.o.b., per tie for carload lots:		6″x8″x8′		7″x9″x8′6″	
		Untr.	Tr.	Untr.	Tr.
Boston	Oak	$1.30	....	$1.80	....
	Pine	1.60	$2.40a	2.40	$3.40a
New York	S. L. Sap Pine	1.30/1.40	2.35	1.60	2.60
	Mixed Oak	1.55	2.35	2.00	2.95
Birmingham	White Oak	1.00	1.60a	1.30	2.25a
	Southern Pine	....	....	....	....
Chicago	Red Oak	....	2.05a	....	2.70a
	Southern Pine	....	....	....	....
Los Angeles	Douglas Fir	1.10	1.75a	1.60	2.50a
Philadelphia	Red Oak	....	1.85a	....	3.00a
St. Louis*	White Oak	1.40	....	1.75	....
	Red Oak	1.40	1.85a	1.75	2.35a
	Sap Pine or Cypress	1.30	....	1.65	....
San Francisco	Douglas Fir	1.25bef	....	....	3.00caf
Montreal	Birch or Maple	.85	....†	.95	....†

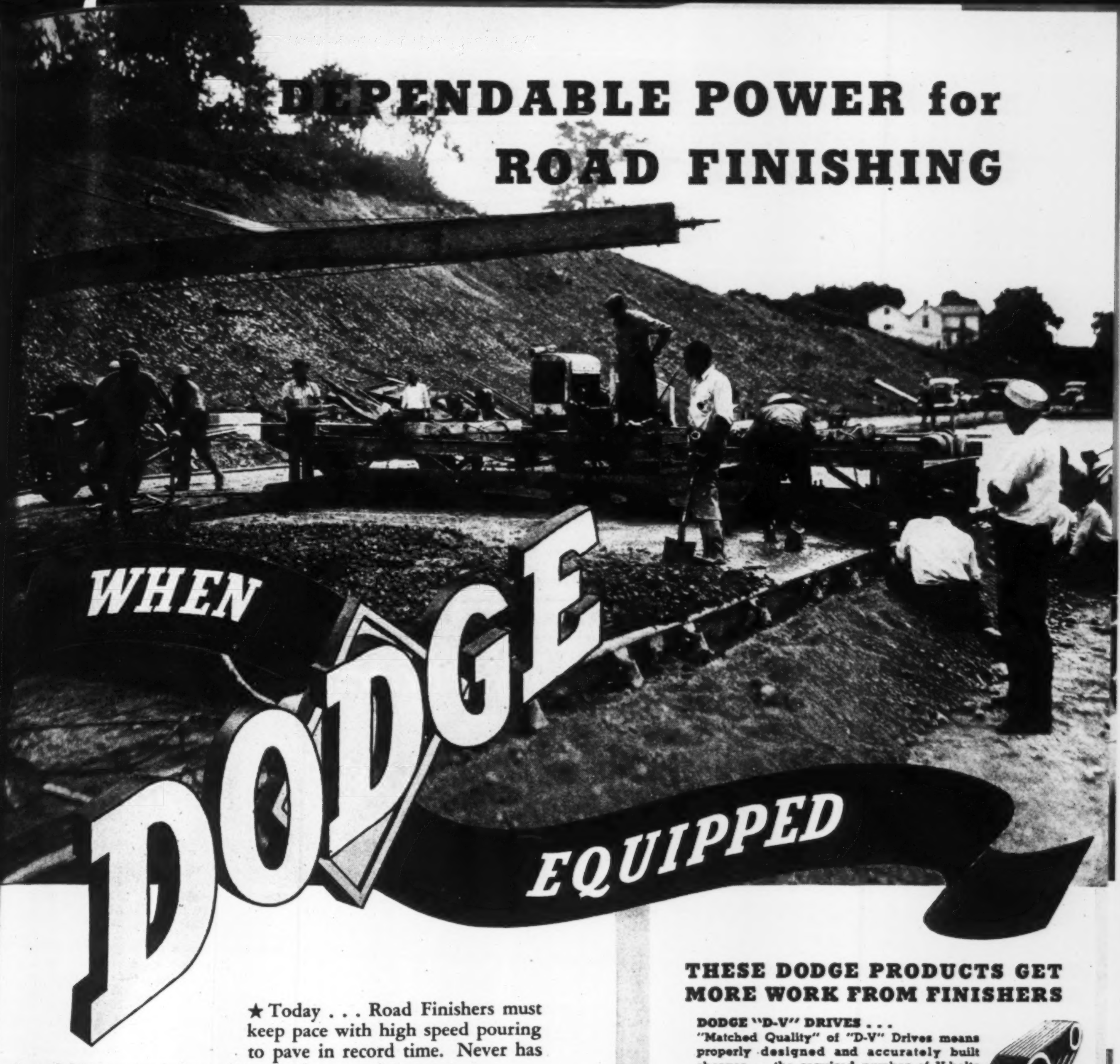
Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6″ x 8″ x 8′6″. *c* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle. *August prices; none later quoted. † Out of market.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.25–3.10
Chlorine cylinders, liquid, per lb. delivered	.0525
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, delivered, per ton	20.50–39.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.15
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00–25.00
Sulphate of copper, in bbl., per 100-lb	5.15–5.50

DEPENDABLE POWER for ROAD FINISHING



★ Today . . . Road Finishers must keep pace with high speed pouring to pave in record time. Never has dependable *transmission of power* been so important.

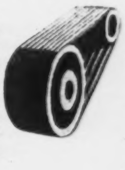
Dodge Power Transmission Equipment, including Rolling Bearings, D-V Drives and Friction Clutches, are being specified by Construction Engineers and Contractors who know that Dodge products have what it takes to produce results. Correctly designed and ruggedly constructed, Dodge units are adapted for driving traction, screeds and vibrators — meeting deadlines with the required accuracy, with a minimum of maintenance.

An additional advantage, of interest in this emergency, is the availability of Dodge power transmission units. A wide range of popular sizes and types are quickly available through a nation-wide network of local industrial distributors.

Dodge engineers will be glad to assist in solving any power transmission design problem. Write for complete engineering information.

DODGE MANUFACTURING CORPORATION
MISHAWAKA, INDIANA, U. S. A.

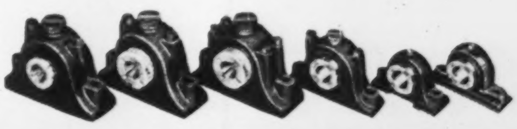
THESE DODGE PRODUCTS GET MORE WORK FROM FINISHERS



DODGE "D-V" DRIVES . . . "Matched Quality" of "D-V" Drives means properly designed and accurately built sheaves — the required number of V-belts selected for their suitability for power transmission service. Sheaves are carefully machined — groove diameters uniform — each belt pulls its full load. Belts have concave side walls for straight surface contact with grooves to reduce wear.

DODGE FRICTION CLUTCHES . . . Powerful . . . simple . . . compact . . . safe. A type to meet every service condition — light, medium and heavy duty.

DODGE ROLLING BEARINGS . . . Available in a wide range of types and sizes. Dodge Rolling Bearings are designed for life expectancy of 30,000 hours under conditions for which they are adapted. They are completely assembled, factory adjusted, pre-lubricated, delivered ready to mount on a shaft. Ruggedness and effective sealing makes them adaptable for use under high speeds, shock loads, dust, water, heat, acid fumes and other severe service conditions.



YOU GET THE MOST FROM DODGE MISHAWAKA . . EQUIPPED FINISHERS

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE — PARTITION — SCORED Per M. lots of 2,000 pieces or over,			STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over,			BRICK Per M. in quantity.		LIME		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Per ton, Hydrated finishing	In paper, Common hydrated	Carload lot, Pulverized or lump
Atlanta	$100.00	$110.00	$195.00	$230.00	$240.00	$240.00	$13.50	$18.00	$26.50	$17.00	$17.00
Baltimore	80.00	85.00	160.00	190.00	255.00	315.00	14.00k	17.00k	18.00	12.00	2.50m
Birmingham	80.00	85.00	160.00	191.00	252.00	288.00	14.50	17.00	18.11	13.64	2.25o
Boston	88.40a	94.30a	176.90a	200.40	260.90	325.00	18.00i	21.00i	21.00	15.00	16.00
Chicago	68.10	72.60	135.90	185.70	234.90	268.10	12.00	14.00	17.00	15.50	12.50
Cincinnati	65.55	69.90	131.20	148.70	210.35	240.45	17.50	17.50	15.40	12.90	......
Cleveland	60.00	64.00	120.00	144.00	193.00	221.00	17.00	17.00	14.50j	13.25j	3.00jm
Dallas	52.00	54.00	100.00	135.00	200.00	263.00	11.50i	13.50i	19.00	15.00	.95n
Denver	84.80	94.40	152.70	178.20	212.00	227.90	13.50	17.00	30.00j	19.00j	30.00j
Detroit	74.50	81.60	153.00	194.00	253.00	289.00e	17.50	18.00	16.50	13.90	14.90
Kansas City	64.50	66.50	86.00c	125.50	159.75	186.25	16.00	24.00	19.10	12.80	10.70
Los Angeles	73.50†r	89.50†r	128.00c†r	210.00†r	368.00†r	460.00†r	13.50	15.00	16.50	17.50	17.50
Minneapolis	81.00b	86.40b	146.90b	.. ...	177.00b	246.00b	13.10	15.10g	21.00	16.00	19.00
Montreal	72.20au	77.50au	142.50au	76.00atu	165.80au	248.70u	22.00†u	27.10†u	23.50u	17.00u	12.00u
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	......	18.30	12.08	14.10
New York	78.40	83.60	115.00c	193.30h	238.80h	295.60h	13.00	......	20.00	14.00	17.00
Philadelphia	82.10	87.60	118.00	197.10	243.20	310.10	17.00s	20.00s	15.50q	10.05q	12.05q
Pittsburgh	62.35	66.55	124 75	140.25	173 25	198.00	17.50	19.50	17.90	15.40	2.55m
St. Louis	62.00	88.00	120.00	180.00	234.00	280.00	17.00	18.00	22.00	18.00	18.00
San Francisco	84.00	94.50	225.00	......	......	......	17.50	22.00	20.00	20.00	16.40
Seattle	105.00	115.00	210.00	......	......	......	18.00f	22.00f	20.00s	20.00s	20.00s

† F.o.b. a Smooth. b Carload lots delivered to job. c 6x12x12 in. d Not load bearing. e 48 lb. tile. f Less $1.00, ½ cash 15 days, balance 30 days. g Selected common. h F.o.b. Perth Amboy, N. J. i 50c. per M. off for cash. j LCL. k $1.00 discount if paid in 10 days. l Lump. m Per bbl., 180 lb. n Per sack 100 lb. o Per bbl., 200 lb. p 280 lb. bag. q 25-ton cars. r 5% discount 10 days. s 2% off cash. t 5½ x 8 x 12. u Plus 8% sales tax.

PAINT, ROOFING—F.O.B. CARLOAD LOTS

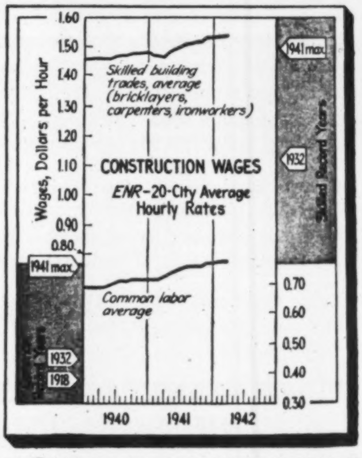
	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl.	WHITE LEAD	READY-MIXED PAINT Per gal., drums			ROOFING SUPPLIES Carload lots f.o.b. factory				
	Dry a	Per 100 lb. in oil	Graphite b	Aluminum c	Ferric Oxide d	Rolls, slate surfaced, 85-90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl, per ton
Atlanta	$10.25	$14.125	$1.30	$2.25	$1.20	$1.90	$1.61	$1.61	$0.27	$29.00
Baltimore	10.00	13.75	1.95	2.90	2.50	2.10	2.50	2.50	.35	30.00
Birmingham	10.25	14.125	2.35	3.50r	1.85	2.04	1.97	1.97	.32	28.35
Boston	10.00	13.75	2.70‡	3.65‡	2.50‡	1.85‡	1.85h‡	1.85h‡	.50‡	20.00‡
Chicago	10.00	13.75	2.11	2.63	1.72	1.55hf	1.50hf	1.50hf	.26f	22.00f
Cincinnati	10.00	13.75	1.70	2.90	1.60	2.40	2.39h	2.39h	.36	21.00
Cleveland	10.00	13.75	2.30	2.90	1.80	1.93	1.83h	1.83h	.40	25.00
Dallas	10.00	14.50	1.88	2.11n	....	2.30h	2.25h	2.45h	.35	39.00
Denver	10.50	14.25	1.65	2.60	.27l	2.45	3.15	3.15	.35	28.00
Detroit	10.00	13.75	1.75	3.00	1.60	2.40	2.50	2.50	.35	21.00
Kansas City	10.00	13.875	2.39g	2.55gr	2.16gn	2.10	2.30	2.30	.28	27.50
Los Angeles	10.25	14.25	1.60	2.25	2.30	2.10	1.50	....	.45	.....
Minneapolis	10.00	13.875	....	....	....	1.75i	1.66hi	1.66hi	.32	23.00
Montreal	9.25	11.07	2.40p	2.97p	2.51p	2.85	2.58	2.01	.63	1.85k
New York	10.00	13.75	2.05	2.55	1.64	1.66	1.58h	1.58h	.26	25.00
Philadelphia	10.00	13.75	....	....	....	1.75	1.66	1.66	.32	23.00
Pittsburgh	10.00	13.75	1.05	1.95	.80	1.95	1.94h	1.94h	.34	26.00
St. Louis	10.00	13.75	1.90/2.00	2.60/2.80	1.60/2.00	1.75	1.66	1.66	.34	23.00
San Francisco	10.25	14.00	1.80	2.75n	1.10/2.00	1.89	2.66	2.66	.33	19.50
Seattle	10.25	14.25	1.90	3.00	....	2.15	2.16h	....	.35	26.50j

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. a Red lead prices change frequently due to pig lead price changes. b U. S. War Dept. Spec. 3–49A. c ASTM Spec. D266–31. d 80% minimum ferric oxide. e Subject to 25% discount. f Distributors' price to contractors. g 5 gal. can h Per roll, 65 lb. i Minneapolis and vicinity. j Asphalt pitch. k Per 100 lb. l Per lb. m Per bbl. n May price, no later quotation available. p Plus 8% sales tax r Not available.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.375	$1.00	$1.375	$1.00/1.25	$1.25	$0.40	$0.50
Baltimore	1.625	1.375	1.65	1.65	1.50	.70	.70
Birmingham	1.75	1.125	1.50	1.50	1.50	.65	.55
Boston	1.50	1.375	1.50	1.875	1.625	.85	.85
Chicago	1.70	1.625	1.70	1.70	1.825	1.025	1.025
Cincinnati	1.625	1.50	1.55	1.325/1.525	1.625	.75	.75
Cleveland	1.75	1.50	1.75	1.75	1.75	1.00	1.00
Dallas	1.50	1.00	1.25	1.00	1.50	.50/.625	.50/.625
Denver	1.65b	1.43b	1.43b	1.43b	1. 51b	.718b	.718b
Detroit	1.60	1.40	1.75	1.625	1.675	.80	.80
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	.50
Los Angeles	1.50	1.175	1.50	1.50	1.667	.75	.75
Minneapolis	1.50	1.25	1.50	1.40	1.50e	.90	.90
New Orleans	1.50	1.25	1.50	1.375	1.375	.55	.55
New York	2.00b	1.85b	2.00	2.00b	2.00c	1.031	.95
Philadelphia	1.825	1.50	1.80	1.65	1.8775	.775	.775
Pittsburgh	1.90	1.50	1.75	1.25	1.75	.80	.70
St. Louis	1.25/1.50	1.50	1.75	1.50/2.00	1.25/1.75	.675/.875	.875
San Francisco	1.75c	1.375	1.60	1.50	1.667c	.875	.875
Seattle	1.715	1.415	1.615	1.565	1.715	1.015	1.10
Montreal	.92	.81	.87	.76	.90	.53	.46

b 7 hr. day. c 6 hr. day. d 35 hr. wk. e 30 hr. wk.



ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $1.538
ENR Common Average: $0.780

TODAY'S TOUGH JOBS CALL FOR TRI CLAD MOTORS

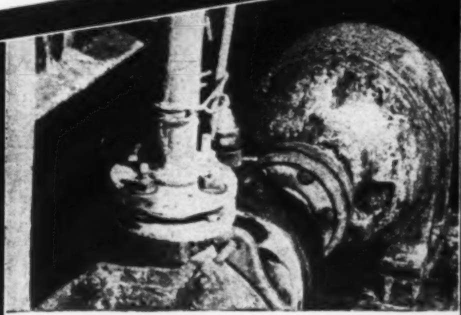
REG. U.S. PAT. OFF.

TODAY, you must be sure the motors you buy will give you 24-hour operation, even on the *tough* jobs. Here's where the Tri-Clad motor becomes a real asset. Its cast-iron frame and end shields are a safeguard against accidental blows. The stator winding is protected against damage from oil, moisture, and heat shock. Improved bearings are enclosed in cast iron, protected against the entry of dust or dirt. Ask your G-E representative for details on types and sizes now available, or write General Electric Company, Schenectady, N. Y.

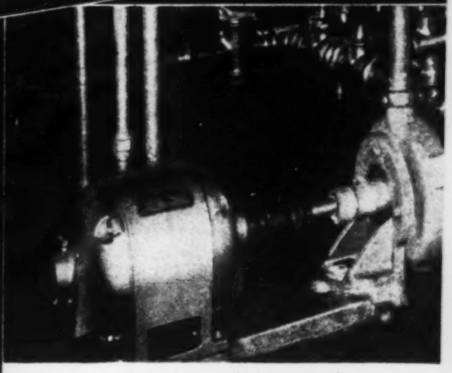
Now available up to 100 HP in standard, open construction

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

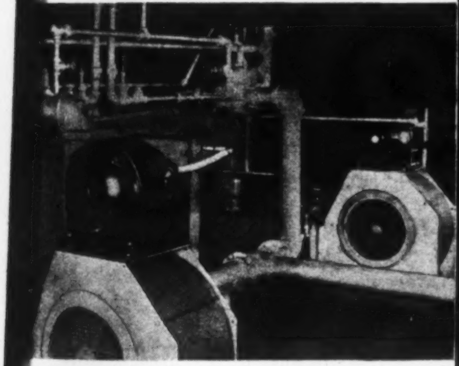
BIG JOB On machines vital to the war effort, Tri-Clad motors are well guarded by their cast-iron frames from metal chips or dripping coolants.



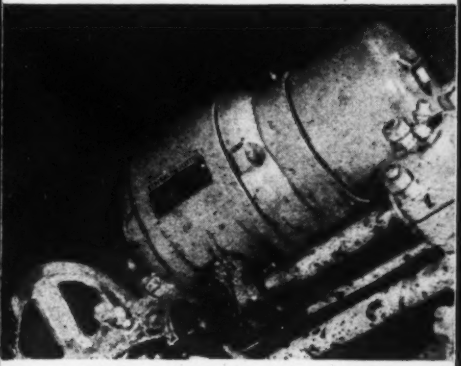
DIRTY JOB Note how dust and fumes have coated this Tri-Clad ball-bearing motor. This is service for which we might not recommend open motors, such as that shown, but we are glad to chalk up this instance of motor stamina under severe operating conditions.



WET JOB Here's a Tri-Clad splash-proof motor close to the floor. Special end shields, watertight conduit boxes, and Formex wire give it *extra* protection against moisture.



HOT JOB These stoker motors are down where red-faced firemen used to sweat. Double-end ventilation and Formex windings with high-heat-transfer advantages give it *extra* protection needed for this service.



HEAVY JOB This Tri-Clad motor is installed on a lift bridge. In these surroundings where grease and grime are ever present, a protective frame is an important factor in continuous operation.

RUSH JOB Here's a Tri-Clad motor at work in the arms industry. The many features of Tri-Clad motors can not only help plants to get important tools into production quickly but will also help keep them in triple-shift operation.

GENERAL ELECTRIC

750-115-8068

Courtesy of Borden Company

TAKE A TIP ON VALVES FROM ELSIE THE BORDEN COW

NOTHING is too good for Elsie. She gets her beauty bath every day, she rides on merry-go-rounds, she gets milked in snow white quarters.

She's made history as Queen of the World's Fair, in the "Dairy World of Tomorrow". . . and probably nowhere else in the world could she have been surrounded by better things in life, or served by better equipment.

It is not by chance that Borden, in specifying equipment for the "Dairy World of Tomorrow", specified Jenkins Valves. For Borden, through many years' experience in many of their 75 model plants throughout the country, have approved Jenkins Valves on the basis of clean operation, low maintenance and long, trouble-free life.

In a typical Borden Plant, the Willow Brook Pasteurizing Plant, Jenkins Valves have served for more than 19 trouble-free years . . . in heating and cooling the milk . . . in sterilizing bottles and cans . . . and on steam and water lines, from start to finish.

Yet, as fine as it is, this record of Jenkins Valves in service in the Borden Company is not exceptional. It is the rule with Jenkins. On file are records of hundreds of valves that have served in continuous operation as much as 50 or more years, with little or no attention, little or no maintenance costs.

Consider these proved records of Jenkins Valve economy when you consider valve replacement for the plant you operate, or installations in the plants for which you write specifications. We believe that, when you do, you'll agree it's just plain commonsense engineering to depend on Jenkins Valves. *Especially as you pay no premium for Jenkins Quality.*

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Available through good supply houses everywhere.

JENKINS VALVES

For every plumbing, heating industrial service—Bronze, Iron, All Iron, Cast Steel Corrosion-Resisting Alloys—⅛" to 36"—125 to 600 lbs. pressure.

MEETINGS

American Railway Engineering Association, Palmer House, Chicago, March 17–19.

American Industrial Hygiene Association, annual meeting, Hotel Gibson, Cincinnati, Ohio, April 13–17.

National Society of Professional Engineers, annual meeting, Ambassador Hotel, Atlantic City, N. J., April 16–18.

American Society of Civil Engineers, Spring meeting, Hotel Roanoke, Roanoke, Va., April 22–23.

American Society of Planning Officials, Indianapolis, Ind., May 24–28.

REGIONAL AND LOCAL MEETINGS

Texas Section, American Society of Civil Engineers, spring meeting, Austin, Tex., March 13–14.

New York State Association of Highway Engineers, annual convention, Park Central Hotel, New York, N. Y., March 19–21.

New Jersey Section, American Water Works Association, spring meeting, Stacy-Trent Hotel, Trenton, N. J., March 26.

Engineering Society of Wisconsin, 34th annual convention, Appleton, Wis., March 26–27.

Montana Section, American Water Works Association, Helena, Mont., April 16–17.

New York State Society of Professional Engineers, annual convention, Hotel New Yorker, New York, N. Y., May 14–16.

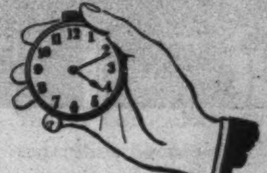
Elections and Activities

Ray Kivell, of Oshkosh, was elected president of the Associated General Contractors of Wisconsin at a recent convention held in Sheboygan. Other officers elected were George Hutter, Fond du Lac, vice president; Elwyn F. Nelson, Jr., Oshkosh, secretary-treasurer; J. Harry Green, Janesville, executive secretary.

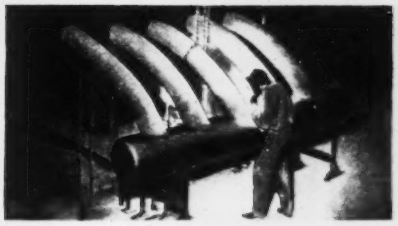
More Than 400 members and guests of the Ground Hog Club of Chicago attended the club's second annual frolic recently in Chicago.

Gerry F. Brandt, of Milwaukee, was elected president of the Wisconsin Master Builders at that organization's annual convention in Milwaukee. John Gyspers, of Waupun, was made treasurer, and

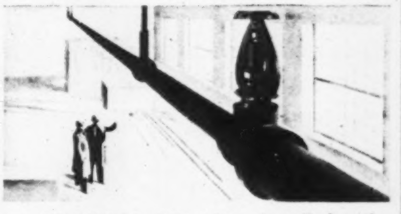
5 Proved Time-Savers for ALL-OUT PRODUCTION



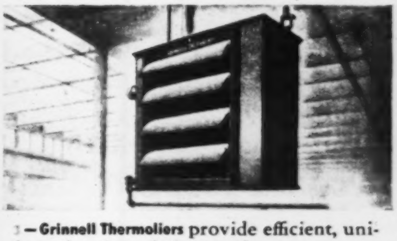
IF ALL OUT PRODUCTION means expansion or reconditioning of your plant, Grinnell can probably save you valuable construction time or help you maintain uninterrupted production, through these 5 services. . . .



1—**Grinnell Prefabricated Piping** saves construction time.

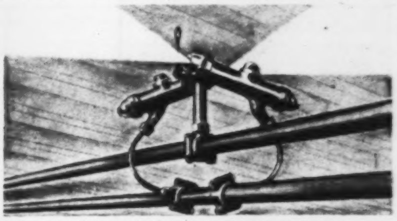


2—**Grinnell Automatic Sprinklers**, installed with minimum disruption, guard against time and material loss by fire.



3—**Grinnell Thermoliers** provide efficient, uniform heating—help speed output.

4—**Grinnell Pipe Fittings** for stronger, tighter pipe connections, minimize repairs and delays.



5—**Amco** Humidification Systems help textile mills speed production of uniforms and defense fabrics.

ONE OF THESE PLANTS OR OFFICES IS NEAR YOU . . .

Grinnell Company, Inc. • Grinnell Company of the Pacific • Grinnell Company of Canada, Ltd. • General Fire Extinguisher Company • American Moistening Company • Columbia Malleable Castings Corporation • The Ontario Malleable Iron Company, Ltd.

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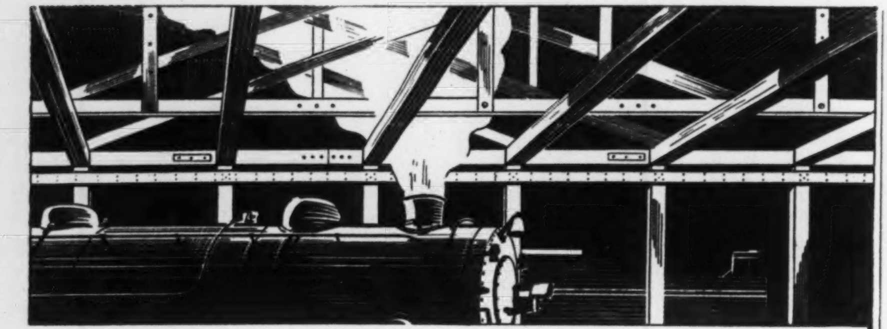
Important!—To save valuable time, please send in your priority certificates *with* your orders.

GRINNELL
WHENEVER **PIPING** IS INVOLVED



Service Records Like This Proved the Worth of Wood

AN ENGINE HOUSE is a trouble-maker for all building materials. Metals are attacked by corrosive stack gases. Ordinary wood soon succumbs to decay hastened by high humidities. Wolmanized Lumber* has proved to be a solution to these problems in roof trusses and decks, window sash and sills.

WOOD IS NATURALLY resistant to corrosion, so its use eliminates that worry. Wolmanizing the wood—vacuum-pressure impregnation with Wolman Salts* preservative —goes a step farther. It gives ordinary wood the ability to withstand decay and termite attack.

FOLLOW THE LEAD of the railroads. They have found in Wolmanized Lumber a means of lengthening the life of their wood structures and reducing maintenance costs. Its use introduces no unusual problems, because Wolmanized Lumber is handled like ordinary lumber. It does not increase the fire hazard.

WOLMANIZED LUMBER gives you all of the usual advantages of wood construction; ease of handling and erection, lightness, strength, resilience and low cost. It is clean, odorless and paintable. "Fibre fixation" prevents washing-out or leaching of the preservative. American Lumber & Treating Company, 1649 McCormick Building, Chicago, Illinois.

*Registered Trade Mark

WOLMANIZED LUMBER

WOLMANIZED
PROTECTED AGAINST DECAY & TERMITES
A.L.&T.CO.

Richard Ferge was reappointed secretary.

Officers Elected by delegates to the eighth annual Montana Contractors Association convention held recently at Helena, include William P. Roscoe, Billings, president; Pierre Herrick, of Butte, vice president; and L. V. Lockwood, of Glasgow, Harry Bjerkness, of Omaha, and J. L. McLaughlin, of Great Falls, directors.

R. S. LaFaye, of Columbia, S. C., has been elected vice-president of the South Carolina Chapter of the American Institute of Architects, to replace Albert S. Thomas, Jr., who has been called to active duty with the U. S. Army.

George W. Koronski, Gogebic County road engineer, was elected president of the Michigan Association of Road Commissioners and Engineers at its annual meeting held recently in Ann Arbor. Ben D. Jeffs, Missaukee County road commissioner, was elected vice president, and L. F. Levin, Chippewa County road engineer, was made secretary-treasurer.

The Michigan Society of Architects recently elected L. Robert Blakeslee, assistant professor of architectural engineering at the University of Detroit, as a vice president of the group. Other officers elected are Cornelius L. T. Gabler, president; Lyle S. Cole, treasurer, and E. W. Pellerin, secretary.

H. G. Van Riper has been elected president of the Engineers Society of Pennsylvania, with headquarters in Harrisburg, to succeed Victor J. Snyder, retiring president. Other officers elected at a recent annual meeting are: H. Hershey Miller of New Cumberland, first vice president; J. C. Dight, New Cumberland, second vice president; Ross H. Swope, Colonial Park, secretary-treasurer; Luther C. Wurster, Harrisburg, financial secretary; Ernest C. Geiger, Camp Hill; Kenneth Caskey, Harrisburg, and Fred L. Eckert, Harrisburg, directors.

John T. Waller, of Hopkinsville, has been elected president of the Association of Kentucky Architects, at a recent meeting at Louisville. Other officers named were: vice president, L. K. Frankel, Lexington; secretary, John L. McDermott, Fort Thomas, and treasurer, Abner E. Foster, Covington.

The Washington State Society of Professional Engineers recently elected James W. Carey of Seattle as president. Joseph E. Wickstrom and Walter W. Weedin, both of Seattle, were elected national director and executive secretary-treasurer, respectively. New vice presidents are Berton W. Huntoon, of Bellingham; Joseph C. Mayer, of Seattle; C. C.

There's Life in the OLD BABY YET ★

Today you have more reason than ever before to be glad that shovels and cranes are built to last for years. Because, even though you find it difficult to obtain a new, modern shovel or crane, you'll also find that the designer of your present equipment has built into it lasting qualities that still enable it to maintain a high performance standard.

This is particularly true of owners of Thew-Lorain machines because of Thew's "Customer Protection" policy—a plan whereby all Thew-Lorain owners can keep their "old-timers" as up-to-date as man and modern materials can make them.

years of hard service
ready under its belt
still battin' out big
rdage for its owner in
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THEW-LORAIN Customer Protection

Thew-Lorain engineers are developing continuously improvements and refinements to make Lorains even better units.

As these improvements are developed, it is Thew-Lorain's policy to design them, often at extra expense, so that they are applicable to as many machines outstanding in the field as possible.

Thus many of the improvements on the newest Lorains can be had for your machine. As you order repair parts, you often will receive newly designed and improved parts instead of the original and obsolete design.

To keep your Lorain right up-to-the-minute and offer you every new operating advantage, every chance to cut costs and maintenance; to keep you from having an out-of-date unit—and more important than anything else today, to "Keep 'em Digging"—that is what is meant by CUSTOMER PROTECTION.

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fficient, Coast-to-Coast Service

THEW CENTER DRIVE

3/8 to 2½ yd LORAINS

These machines are representative examples of the wide variety of applications of Briggs & Stratton motors

CREAM SEPARATORS

FLEXIBLE SHAFT GRINDERS

INDUSTRIAL TRUCKS

Final INSPECTORS KNOW—

"It's powered right when it's powered by Briggs & Stratton"

In the plants of hundreds of manufacturers where gasoline-powered machines, tools, and appliances are manufactured, the highly trained and skilled inspectors who put their "OK" on completed products readily grant their approval of the power unit when it's a Briggs & Stratton gasoline motor.

Briggs & Stratton precision manufacture—tested quality and proven performance are well known and accepted wherever gasoline-powered equipment is manufactured.

BRIGGS & STRATTON CORP., Milwaukee, Wisconsin, U. S. A.

4 CYCLE BRIGGS & STRATTON GASOLINE MOTORS

Casad, of Bremerton; Donald G. Felthous, of Longview; C. F. Griggs, Spokane; Grova C. Cookerly, Walla Walla, and Leland J. Wright, Mount Vernon.

A NEW ORGANIZATION, to be known as the Water Conservation Association of South Dakota, was formed at a recent meeting at Aberdeen. Elected as president was C. E. Arnold, of Aberdeen, and other officers included C. Irvin Krumm, of Huron, vice president, and Fay Stewart, of Stratford, second vice president.

HOLDING ITS FIRST annual convention, the New Mexico Society of Engineers recently elected C. B. Byer, Bernalillo County engineer, as president of the group. Over 250 engineers attended the meeting at Albuquerque, which was held during the closing business session of the seventh Highway Engineering Conference held at the University of New Mexico. Other officers elected were E. B. Bail, vice president; W. C. Wagner, Albuquerque, secretary.

R. E. Lindsay, chief engineer of the Mountain States Telephone and Telegraph Co., was elected president of the Colorado Society of Engineers at their annual meeting held in Denver. Roy A. Klein, senior engineer with the Public Roads Administration, was elected vice president, and C. M. Lightburn was reelected secretary.

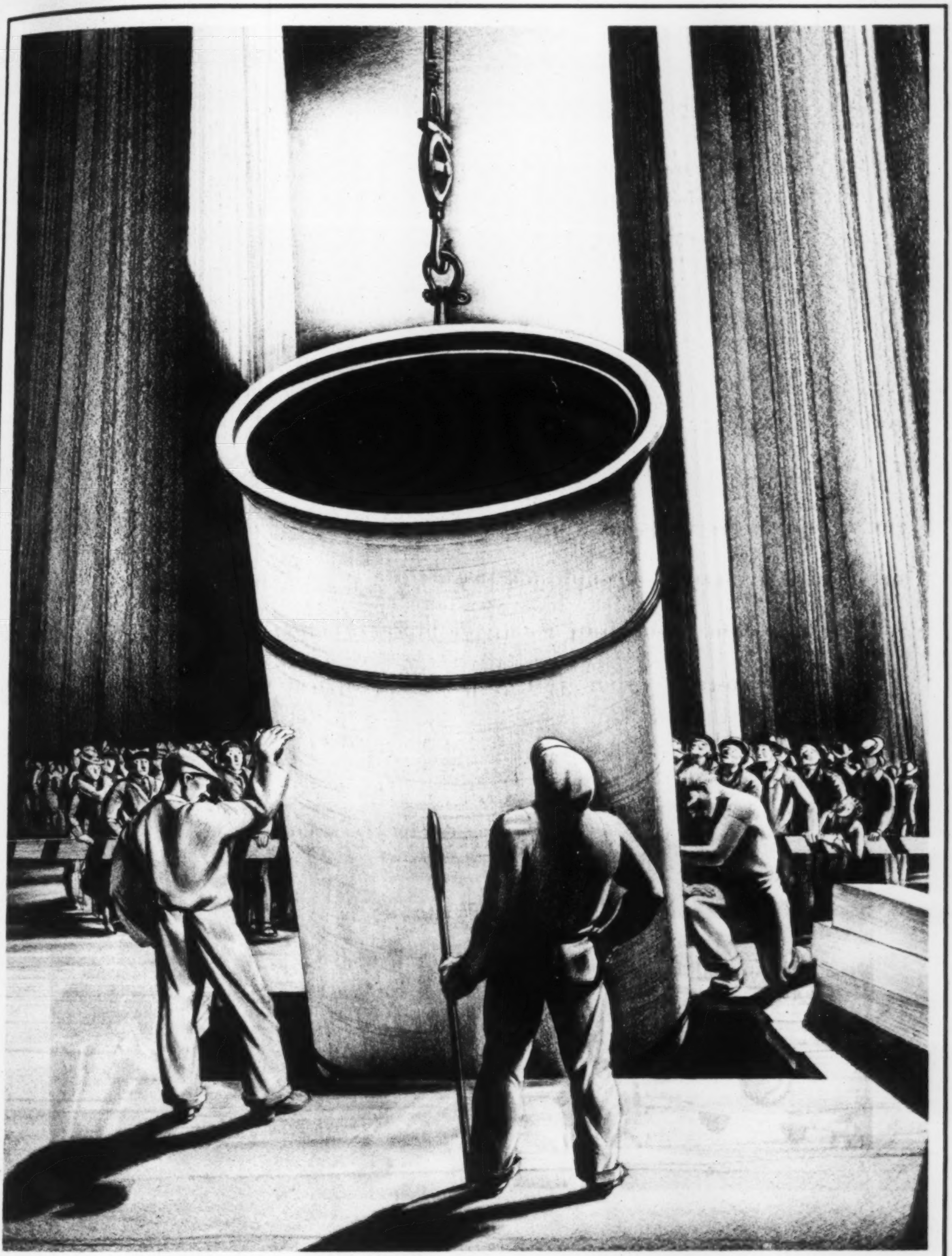
THE ARKANSAS ENGINEERS CLUB recently elected E. F. Nelson, of the Arkansas State Highway Department, as its president.

P. C. HOSFIELD, city engineer of Owatonna, Minn., has been named temporary chairman of the Minnesota municipal engineers, at their recent meeting held in Minneapolis.

A. P. LINTON, bridge engineer of the Department of Highways of Saskatchewan, Canada, has been elected president of the Association of Professional Engineers of Saskatchewan.

THE ENGINEERS' CLUB of Northern Minnesota has named H. M. Pickering, president; A. J. Probst, vice president, and L. M. Becker, secretary-treasurer, at their annual meeting held recently in Hibbing.

THE ASSOCIATION of State Levee Boards of Louisiana was organized at a recent meeting in Baton Rouge, with Arden B. Smith, president of the Tensas Basin Levee District, as president. Other officers included W. C. Hudson, president of the Red River, Atchafalaya and Bayou Boeuf Levee District, vice president, and DeWitt Pyburn, director of the state department of public works, secretary-treasurer.



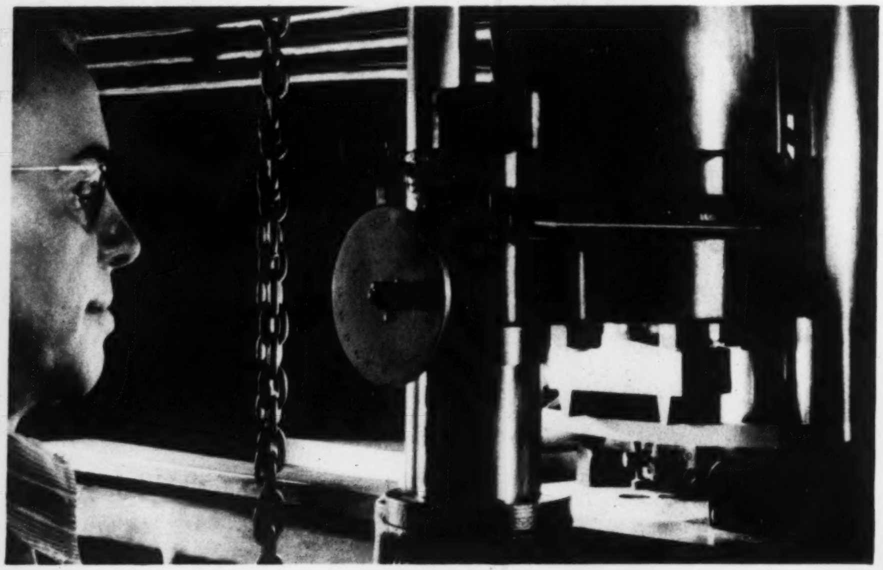
LITHOGRAPHED ON STONE BY ROCKWELL KENT

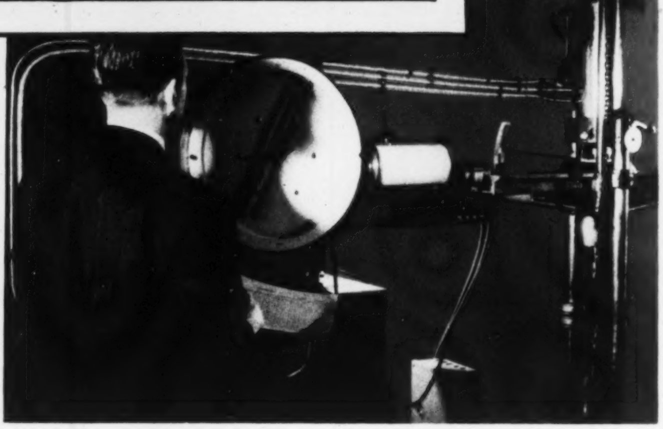
UNITED STATES PIPE AND FOUNDRY COMPANY

BURLINGTON, NEW JERSEY

America's Largest Producer of Cast Iron Pipe for

Water, Gas, Sewerage, Drainage and Industrial Service





* The "Talbot Strip Test," illustrated above, is an acceptance test for cast iron pipe. The modulus of rupture and secant modulus of elasticity are determined from this test, made on a strip cut from the wall of a pipe. It is one of the routine tests made by this Company to insure that the quality of its pipe meets or exceeds the requirements of accepted standard specifications for cast iron pipe.

*** One of a series of controls in operation at each of our plants, beginning with inspection and analysis of raw materials and ending with tests of the finished product, all subject to the central control of our headquarters staff at Burlington.**

U.S.
cast iron
PIPE

Centrifugally or Pit Cast for water, gas, sewerage, drainage and industrial services.

Prof. Ben H. Petty of Purdue University was elected chairman of the Indiana section, American Society of Civil Engineers, at a meeting in Indianapolis Feb. 14. M. R. Keefe, State Highway Commission engineer, was elected vice-chairman, and Deuzil Doggett, Conservation department engineer, was re-elected secretary-treasurer.

Norman R. Brigham of Omaha was named president of the Nebraska chapter of the American Institute of Architects at an annual meeting held recently. Other officers were: Edward G. Schaumberg, Lincoln, first vice president; Frank Latenser, Omaha, second vice president; William L. Younkin, Lincoln, secretary-treasurer.

The **Minnesota County Engineers'** association recently elected John G. Merten of Stillwater, Minn., as president.

H. R. F. Helland, San Antonio, is the new president of the Texas Society of Professional Engineers. Other officers elected at a recent meeting are: R. B. Cruise, Beaumont, and T. B. Warden, Austin, vice presidents, and Robert Coltharp, Austin, secretary-treasurer.

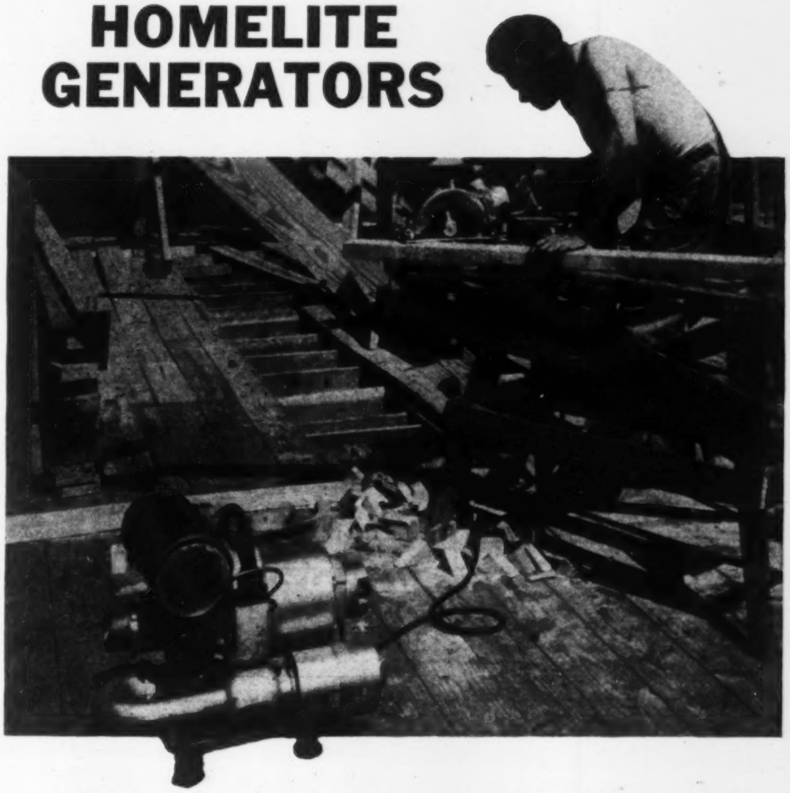
At the twentieth annual convention of the central branch Associated General Contractors of America, E. M. Duesenberg of Clear Lake, Ia., was elected president; E. B. Spender, Waterloo, vice president; F. H. Carlson, Decorah, vice president; Paul B. Reis, Des Moines, treasurer.

Officers Elected at the recent annual meeting of the Associated General Contractors of Massachusetts included Mathew J. Cummings, of Boston, president; John A. Volpe, of Malden, vice-president; M. Murray Weiss, of Boston, treasurer; and Edmund J. Rappoli, of Cambridge, secretary.

Federal, State and Municipal engineers will convene at Tucson, Ariz., Mar. 20–21 for the fifth annual Arizona Conference of Roads and Streets. G. L. McLane, senior highway engineer of the Public Road Administration, Phoenix, will preside over the sessions, sponsored by the Arizona section of the American Society of Civil Engineers, the Arizona Highway Department, and the University of Arizona.

Gordon McL. Pitts, Montreal architect, was elected president of the Royal Architectural Institute of Canada at the closing session of the Institute's convention in Montreal recently. Other officers chosen were: J. F. Watson, of Vancouver, first vice president; A. Cobb, of Halifax, second vice president; Alcide Chausse, of Montreal, secretary emeritus, and Forsey Page, of Toronto, honorary treasurer.

Finish the job
AHEAD OF SCHEDULE
with the help of
HOMELITE
GENERATORS



Action is what we need these days. And action is what you get with a Homelite Portable Generator. Light enough for one man to pick up and carry, one of these units can be set up anywhere on the job making electric power instantly available for operating all kinds of portable power tools. More than that, you can use a Homelite to operate brilliant floodlighting on night work. The model shown, weighing only 83 pounds, generates 1800 watts—enough power to run several lamps or tools at the same time.

Rugged in every respect, these gasoline engine driven, self-operating generators can be depended upon to give faithful, continuous service under all conditions.

KEEP YOUR HOMELITES ON THEIR TOES

- Keep your Homelites in good condition.
- Mix ½ pt. of No. 30 oil with each gallon of gasoline used.
- Don't use the choke for a throttle.
- Keep spark plugs in good condition.
- Keep the carburetor set on the lean side.
- Keep engine free of carbon.

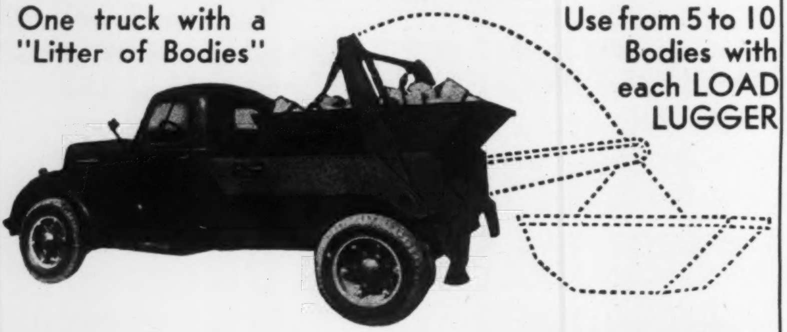
Send for this book

A Homelite is rugged—but with all good machines a little care saves a lot of wear. Send for this operating instruction manual that shows how to keep Homelites running longer and better.

HOMELITE CORPORATION
2903 RIVERDALE AVE., PORT CHESTER, N. Y.

One truck with a "Litter of Bodies"

Use from 5 to 10 Bodies with each LOAD LUGGER



Equip your trucks with Brooks LOAD LUGGER

Ask about our Special Introductory Offer. Catalog No. 44 sent on request.

That is the way to utilize your present trucks to better advantage and to get more payloads hauled per day with less wear and tear on your equipment. It makes hand loading far more efficient, and eliminates idle time by *continuous* hauling . . . picking up loaded buckets and dumping them while the empties are being filled at convenient points on the job.

This powerful hoisting-dumping unit can be mounted on any standard chassis and operated by a power take-off from the truck engine. Only 15 seconds required to hoist or dump load.

Brooks EQUIPMENT AND MFG. CO.

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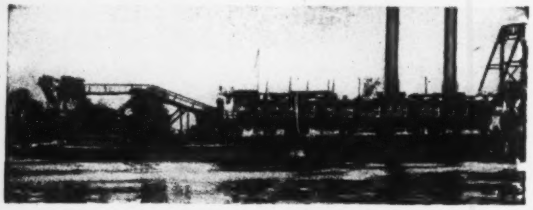
DREDGING



Filling, Land Reclamation, Canals and Port Works

River and Harbor Improvements
Deep Waterways and Ship Channels

We are equipped to execute all kinds of dredging, reclamation and port work anywhere in the United States

Contractors to the Federal Government

Correspondence invited from Corporate and Private Interests Everywhere

Largest Plant — Longest Experience

Atlantic, Gulf and Pacific Co.

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MEN AND JOBS

Pennsylvania's Department of Highways has announced the appointment of **George K. Clark,** of Indiana, Pa., as resident engineer for the department in District 10, with headquarters at Indiana, Pa.

Richardson F. Cuthbert, formerly an engineer with Engineers, Ltd., general contractors, has taken a position with the Macco Construction Company as an engineer on construction of the Barker Dam, near Houston, Tex.

E. W. Bauman, formerly highway materials engineer for the Republic Steel Corp., at Cleveland, O., has become a technical adviser to the non-metallics mining branch, War Production Board, stationed at Washington, D. C.

Jean P. Carriére, civil engineer and senior assistant engineer in the Montreal office of the Department of Public Works of Canada, is now serving as a captain with the Royal Canadian Engineers in England.

Harry D. Lovering, president of the St. Paul Builders Exchange and a member of the American Society of Civil Engineers, was called to active duty with the U. S. Army Mar. 2.

Tom R. Johnson, formerly field engineer on the construction of the Parker Dam power plant, Parker Dam, Cal., has been called to active duty as a lieutenant in the Civil Engineer Corps of the U. S. Navy, stationed at Porto Rico.

Alvin C. Bromm, highest ranking candidate in the Milwaukee (Wis.) city service commission examination for the position of city planner, has been named to the post by the Milwaukee land commission. Bromm, 46, a graduate of the University of Illinois, has been senior engineer in the Cincinnati (Ohio) city planning department.

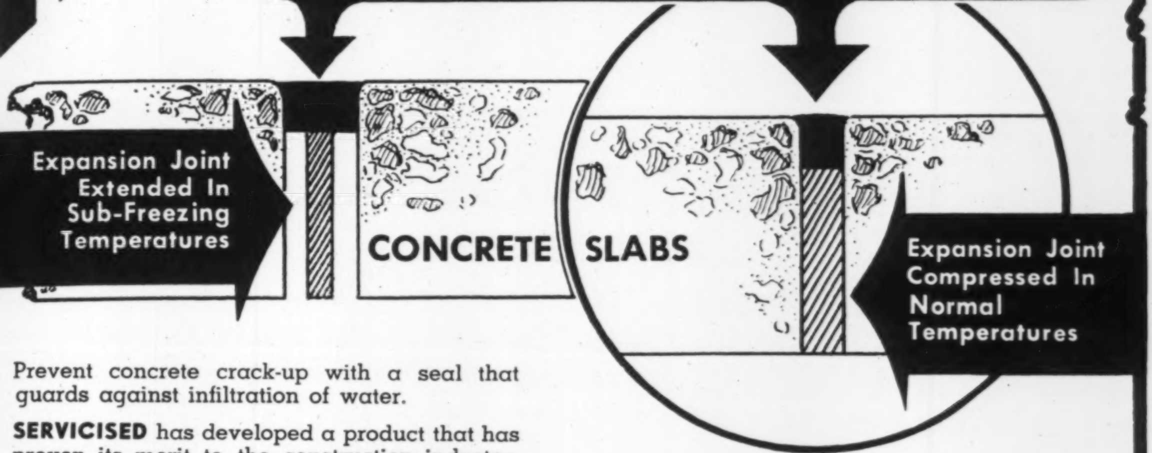
Recent promotions in the engineering department of the Union Pacific Railroad, at Omaha, Neb., include: **John Gogerty,** to general superintendent of motive power and machinery; **R. F. Weiss** to superintendent of motive power and machinery; **G. H. Trout** to the newly created position of assistant chief engineer, and **L. P. Drew** to bridge engineer.

Charles E. Houston, of Houston, Tex., has been appointed associate professor of engineering at the University of Houston. He has been a part time instructor at the University for the past two years.

Ellis L. Armstrong, formerly assistant engineer for the U. S. Bureau of Reclamation on the Deer Creek Dam at Provo,

HOLD THAT CONCRETE

WITH *Para-Plastic* HOT POURED RUBBER SEALING COMPOUND


Expansion Joint Extended In Sub-Freezing Temperatures
CONCRETE SLABS
Expansion Joint Compressed In Normal Temperatures

Prevent concrete crack-up with a seal that guards against infiltration of water.

SERVICISED has developed a product that has proven its merit to the construction industry. This compound, known as **PARA-PLASTIC**, is composed of asphalt and rubbery materials and is hot-poured. It liquifies readily and pours easily.

PARA-PLASTIC is superior to other sealing compounds because of its interesting functions. It bonds firmly with concrete even in zero degree temperatures and is resilient at all times.

This hot-poured seal is well recommended for concrete highway construction, airport runways and reservoirs. **PARA-PLASTIC** is nationally known and is recognized by various State Highway Departments and U. S. District Engineers.

ENGINEERS should investigate the mighty "gripping merits" of this fine product.

SERVICISED EXPANSION JOINTS

Another great service contributed by **SERVICISED** to the construction industry are the well known Servicised Expansion Joints. We are the only manufacturers' of all of the various types of premoulded expansion joints such as:

ASPHALT—FIBER—CORK—CORK-RUBBER—SELF-EXPANDING CORK—SPONGE RUBBER—WATERSTOP

The WATERSTOP EXPANSION JOINT is rapidly becoming known as "the water-tight seal". This product is a departure from the other types of expansion joints. Constructed of fibrous and water-proofed asphaltic materials, we have added to this joint a rubber lobe that will provide a definite seal against any infiltration of water.

Right now, our many products are servicing National Defense Projects on a large scale. Make **SERVICISED** your headquarters for the various construction material requirements.

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We have company representation in principal cities. A nearby representative will gladly assist you upon request—or you may send for further information and descriptive literature today.

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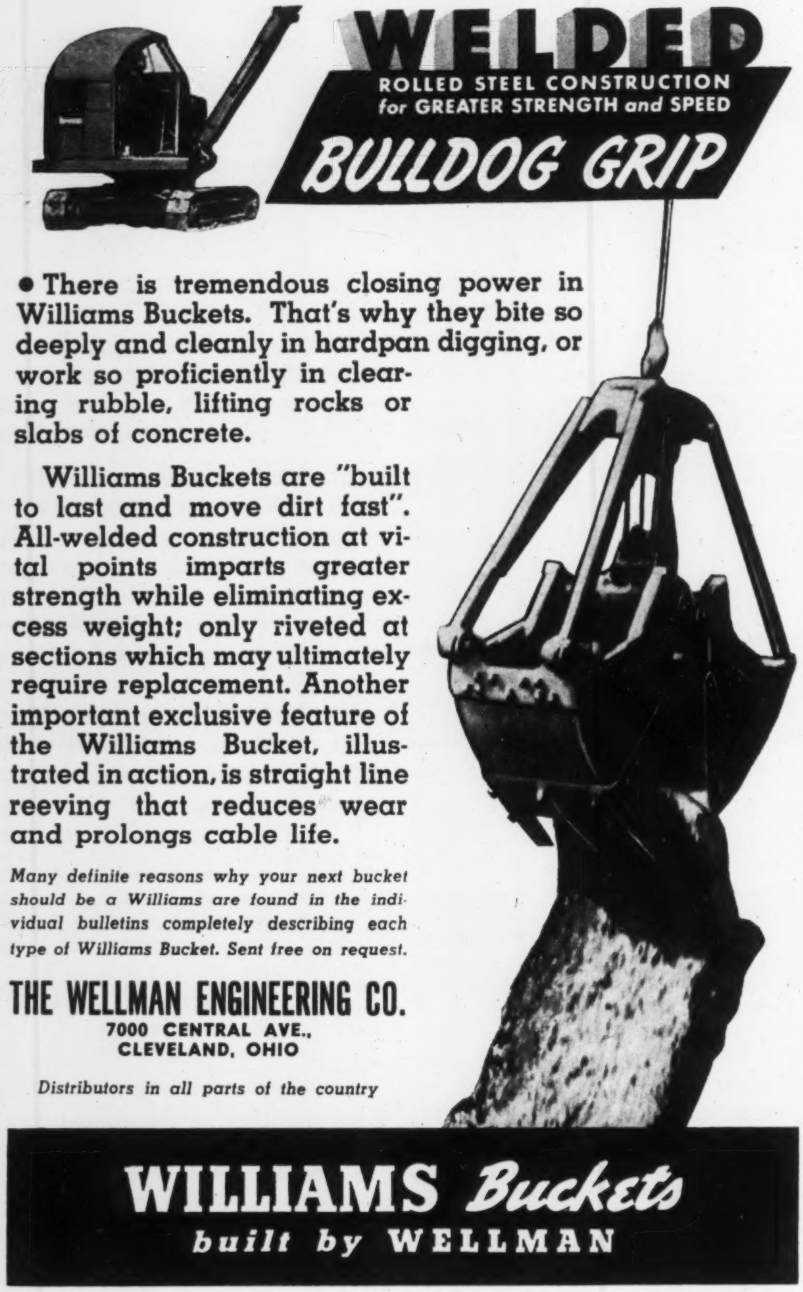

WELDED
ROLLED STEEL CONSTRUCTION for GREATER STRENGTH and SPEED
BULLDOG GRIP

• There is tremendous closing power in Williams Buckets. That's why they bite so deeply and cleanly in hardpan digging, or work so proficiently in clearing rubble, lifting rocks or slabs of concrete.

Williams Buckets are "built to last and move dirt fast". All-welded construction at vital points imparts greater strength while eliminating excess weight; only riveted at sections which may ultimately require replacement. Another important exclusive feature of the Williams Bucket, illustrated in action, is straight line reeving that reduces wear and prolongs cable life.

Many definite reasons why your next bucket should be a Williams are found in the individual bulletins completely describing each type of Williams Bucket. Sent free on request.

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Distributors in all parts of the country

WILLIAMS *Buckets*
built by WELLMAN

We can help solve your problems on
SLUDGE • GUM
VARNISH • RUST
and CORROSION
in all types of engines and fuel tanks

SEND FOR ENGINEERING AND SERVICE DATA

PETROLEUM SOLVENTS CORPORATION
331 MADISON AVENUE, NEW YORK, N. Y.
Manufacturers of additives for motor oils and solvents for all types of petroleum residues

Utah, has become assistant engineer for the Bureau at the Anderson Ranch Dam, Mountain Home, Idaho.

Irvin L. Simmons, bridge engineer of the Rock Island Railroad since 1909, retired from that post Mar. 1, after 39 years in the engineering department. A resident of Evanston, Ill., Mr. Simmons is a member of the American Society of Civil Engineers, the American Railway Engineering Association, and the American Railway Bridge and Building Association.

John C. Everrett, for the past two years supervisor of the WPA in Van Buren County, Ark., has been transferred to Crawford County. He was succeeded in Van Buren County by Ray Clutts, of Clinton, who has been WPA field supervisor in the county for the past three years.

Clyde H. Spencer, formerly assistant to Construction Engineer **Dean S. Stuver** in the U. S. Bureau of Reclamation, has been appointed construction engineer for the Bureau in charge of the $8,400,000 Deschutes project near Bend, Ore.

Charles LeMoyne, assistant engineer in the canal division of the Deschutes reclamation project at Bend, Ore., has been called into active service with the U. S. Army.

George W. Williams, of Shelbyville, Ill., has been appointed superintendent of the division of parks and memorials in the state department of public works and buildings.

Gibson Morris, formerly connected with the U. S. Engineers at Nashville, Tenn., has joined the James Stewart Company Associates, contractors for the U. S. Naval Air Station in Trinidad.

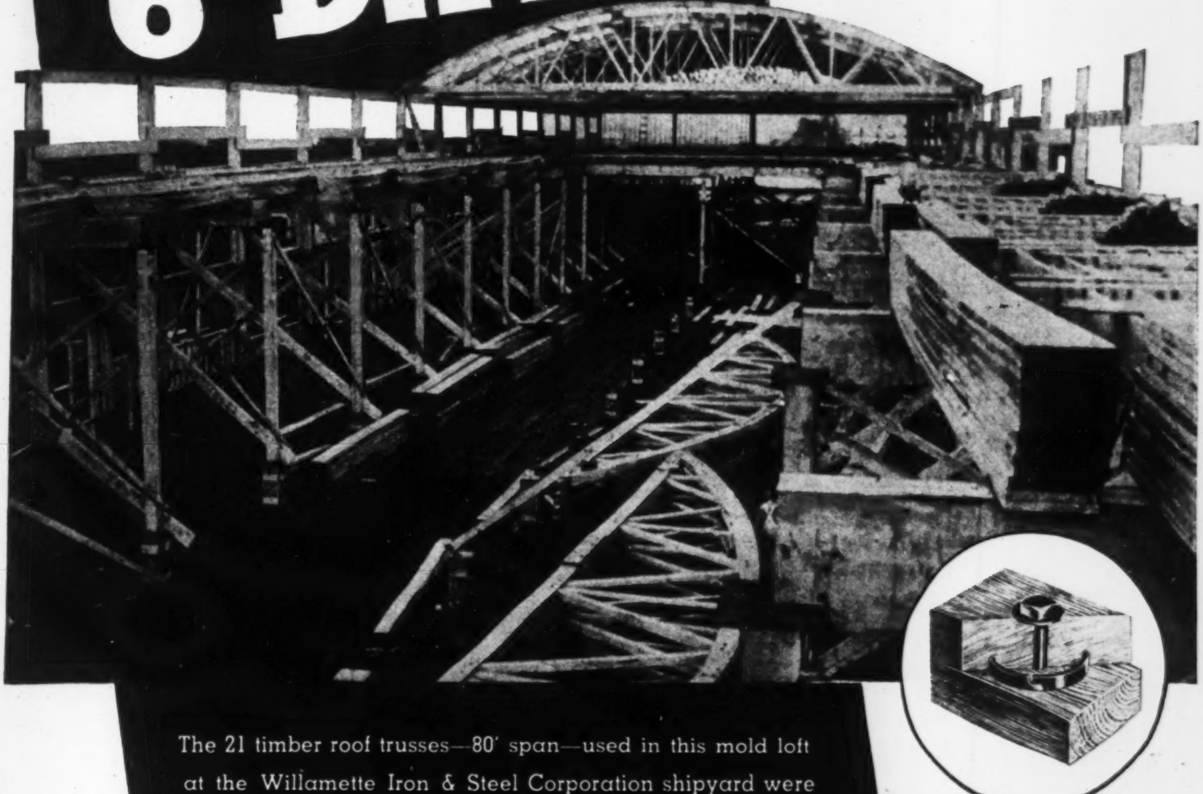
F. W. Edwards, formerly senior hydraulic engineer for the Panama Canal, has accepted a position as senior engineer in the South Atlantic Division, office of the U. E. Engineers, at Atlanta, Ga.

Leo C. High, district WPA engineer at Durham, N. C., has been made district WPA safety engineer to succeed **R. E. Paschall** of Raleigh, N. C., who resigned recently to enter naval service.

Robert Koerner, who has been associated with the county engineer's office of Franklin County, Ohio, since 1937, has been promoted to the post of chief deputy, to fill the vacancy caused by the recent death of **Edward Linzell.**

Robert D. Williams, a member of the faculty in the department of mechanical engineering at the University of Illinois,

DELIVERED IN 6 DAYS



The TECO Ring Connector spreads the load on a timber joint over practically the entire cross-section of the wood.

The 21 timber roof trusses—80′ span—used in this mold loft at the Willamette Iron & Steel Corporation shipyard were framed, assembled and delivered ready-to-erect in 6 working days after final lumber delivery.

Speedy and efficient construction of buildings ranging from small storage sheds to giant mold lofts, like this, is assured through use of the TECO Connector System of Timber Construction and a new engineering service offered to users of wood.

For complete information on how the TECO System can help solve your emergency building problems, fill in and mail the coupon.

Timber Engineering Company, Inc.
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Please send us complete information on the TECO Connector System of Timber Construction.

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FIRM ....

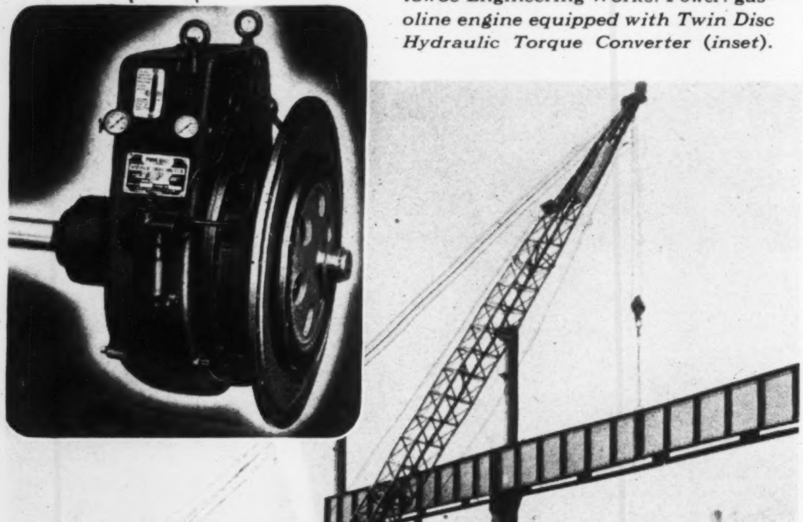
STREET .... CITY .... STATE ....

Inching Steel Beams into Place

A Twin Disc Hydraulic Torque Converter will give your gasoline- or diesel-powered crane the flexibility of steam. By means of the Converter, you can safely hold heavy beams in the air, in any position, while inching them into place smoothly and accurately with no chance of stalling the engine . . . no shifting of gears . . . the whole operation controlled by the engine throttle due to the automatic torque-speed adjustment of the Torque Converter.

Bulletin 132 gives you a complete description of hydraulic drives: both the Hydraulic Torque Converter and the Hydraulic Clutch, together with typical installation examples. We will gladly mail a copy to any interested engineer or executive. TWIN DISC CLUTCH COMPANY, 1327 Racine Street, Racine, Wisconsin.

Speedcrane manufactured by Manitowoc Engineering Works. Power: gasoline engine equipped with Twin Disc Hydraulic Torque Converter (inset).



has joined the technical staff of Battelle Memorial Institute, Columbus, Ohio, as a research engineer.

Maj. Stanley C. Shubart, member of the firm of Shubart & Schloss, engineers of Denver, Colo., and formerly field service officer at the Denver Ordnance Depot, has been transferred to command at the Longhorn Ordnance Works at Karnack, Tex.

Richard Irvin, Pittsburgh architect and engineer, has been appointed WPA director for Pennsylvania to replace **Col. Phillip Mathews,** who resigned recently.

D. E. Woozley, chief engineer of the Union Ralroad Co., East Pittsburgh, Pa., has become consulting engineer to the company with offices at Pittsburgh. **H. A. Sayre,** formerly principal assistant engineer, has been appointed chief engineer.

Leon Maslan, formerly assistant civil engineer for the U. S. Department of Agriculture, Soil Conservation Service at Idaho Falls, Idaho, has joined the U. S. Engineers at Savannah, Ga., as assistant civil engineer.

R. M. Morris, formerly a member of the staff of the Shawinigan Engineering Co. at Montreal, Canada, recently accepted a post with the National Research Council in the department of physics and electrical engineering at Ottawa.

Edward W. Stearns is now project engineer for the Corbetta Construction Co. on warehouse construction at Columbus, Ohio.

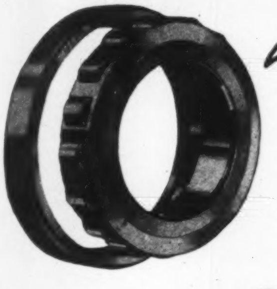
Gerald E. Arnold, chief water purification engineer for the water department of San Francisco, Cal., has been appointed regional sanitary engineer for the Ninth Civilian Defense Region, including California, Idaho, Montana, Nevada, Oregon, Utah, and Washington. In his new post, Mr. Arnold will hold the rank of sanitary engineer (Reserve) in the U. S. Public Health Service.

John M. Parker, 3rd. of the North Carolina State College Department of Geological Engineering, has been granted a leave of absence to accept an appointment with the U. S. Geological Survey. He will investigate sources of aluminum ore and other strategic materials necessary for national defense.

Grady C. Stone, who recently was project engineer for the USHA project at Barksdale Field, La., is now project engineer for the USHA at Meridian, Miss.

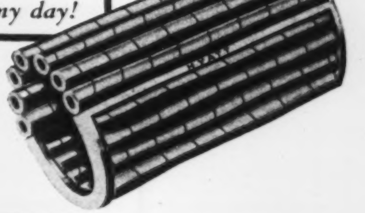
Byron S. Marsh of Bryson City, N. C., engineer with the North Carolina Highway and Public Works Commission for

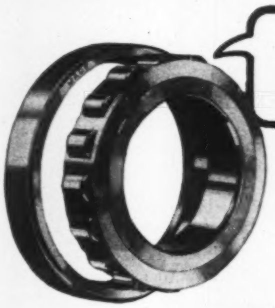
Said 1942 to 1892



1942: Hi, Old Timer!

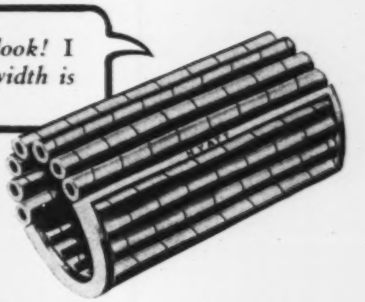
1892: *A little more respect, please. I'm the daddy of our great line of Hyatt Bearings! With a tolerance of .010 in my wound roller diameters I was the Number One bearing of my day!*

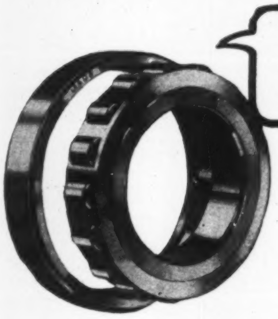




1942: Okay Dad, but with my modern design and close tolerance of one ten-thousandth of an inch, I'm the "fair-haired boy" today.

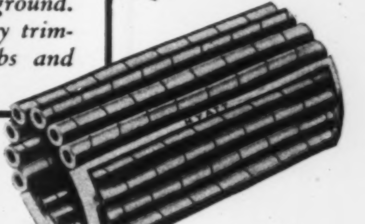
1892: *Hmph! But how skinny you look! I had a width of 6-7 inches while your width is only 1-1½ inches, young fellow.*

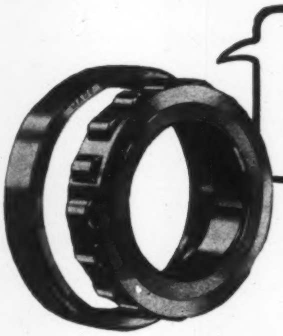




1942: I'm streamlined, old man, but what capacity I possess. And I'm a pretty slick article with my inner and outer race, and my ultra finish.

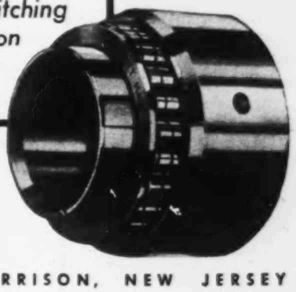
1892: *I know . . . I've watched you develop over fifty years. Sure I was made of only low carbon steel and my finish wasn't even ground. In my day, we didn't have all the fancy trimmings—but we handled the tough jobs and handled them well!*





1942: I appreciate all that, old fellow, but think how out-of-place you would be today with that crude half-spacer roller retainment as compared to my swanky bronze cage and microscopically finished solid rollers and races.

1892-1942: You're right, lad. But look me over now. Other than in roller design I've changed considerably during these years. And I'm still in there pitching with you where applications call for my lubrication features and shock load advantages. So—give credit where credit is due!



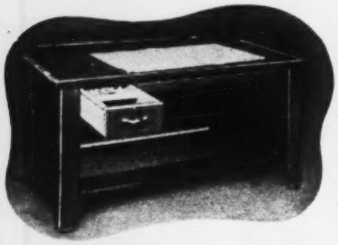
THE 50TH YEAR OF

HYATT ROLLER BEARINGS

HYATT BEARINGS DIVISION, GENERAL MOTORS CORPORATION, HARRISON, NEW JERSEY

SPEED UP
DRAFTING

● You can speed up your drafting room production and reduce operating costs if you install new and improved Hamilton Auto-Shift Drafting Tables. Instant adjustment of height and slope of board mean less fatigue . . . no cramped muscles from drawing in one position. Auto-Shifts not only save operating costs, but conserve valuable floor space. One table and chair occupy 36¼ square feet. All raising mechanism is concealed.



Adjustable Reference Surface:

● The adjustable reference surface is a new feature on Auto-Shift Tables. The hardwood reference surface is made to slide forward 8″, thus increasing the reference working surface.

Write department ENR 342 for full details on the new improved Auto-Shift Tables.

Hamilton
MANUFACTURING COMPANY
TWO RIVERS WISCONSIN

Hamilton DRAFTING ROOM FURNITURE

the past several years, has accepted a position with TVA as associate engineer in the department of highways and railroads.

Col. John J. O'Connor, area engineer of the Hoosier Ordnance Plant, Charlestown, Ind., has been assigned to the Keystone Ordnance Works, Meadville, Pa.

Ralph Reed, city engineer of Watertown, S. D., has resigned that post to join the U. S. Engineers at Fort Peck as a civilian employee.

Lt.-Col. J. L. Dansereau, formerly district engineer for Montreal in the federal department of public works, of Canada, has been appointed to command Le Regiment de Chateauguay, a unit of the Canadian army.

Manufacturers' Activities

Frank T. Bumbaugh has been appointed assistant manager of sales, Alloy Division, Carnegie-Illinois Steel Corp. Mr. Bumbaugh, who was formerly metallurgical engineer on bar and semi-finished products, in Pittsburgh, will make his headquarters at the company's Chicago offices, 208 South LaSalle St.

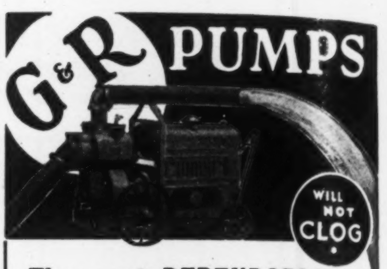
The Gunite Concrete Construction Co. of Kansas City, Mo. has appointed the Western Steel Products Co. of Denver, Colo. as their representative for that territory.

Donald G. Sherwin, vice president and director of the Caterpillar Tractor Co., died recently in California. For several years he had administrative direction of the advertising, sales and treasury departments of the company, but since 1940 has coordinated the activities on the coast with those of the Peoria, Ill. office.

Clifford R. Hutcheon, formerly vice president and chief engineer of Pland-Aire, Inc., of Pittsburgh, has joined the engineering staff of the Dorex Division, W. B. Connor Engineering Corp., New York.

W. D. Low, of Montreal, formerly a member of the purchasing department of the Canadian National Railways, has been appointed as executive assistant to the deputy minister of munitions of Canada.

The Lincoln Electric Co., of Cleveland, Ohio, recently announced changes of address of six of its field offices. The changes are: Oklahoma City, Okla., office now located at 19 North Ellison St.; Milwaukee, Wis., office now at 733 North Van Buren St.; Chattanooga, Tenn., of-



The most DEPENDABLE Pump for the Least Money

Claims of fastest priming, highest suction lift, more gallons per minute, etc., do not pump water. On the job, the pump must do its own talking, and with dirty water, many a pump is inclined to stutter—and stop.

Let G & R Pumps tell you their own story on any job. They will deliver as much, and usually more, water under any condition, than any other pump. We will ship you one and let you be the judge.

Remember this about G & R Pumps —THEY WILL NOT CLOG—THEY ASK NO TIME OUT. Play safe! That is why more contractors are standardizing on G & R Pumps than on any other make.

Distributors in 100 principal cities are ready to make prompt delivery of the G & R Pumps you need.

THE GORMAN-RUPP CO. Mansfield, Ohio

KEEP YOUR CONVEYOR BELTS GOING

FLEXCO H D RIP PLATES are used in repairing rips and patching conveyor belts. Their use saves expensive replacements and extended shutdowns.

FLEXCO H D BELT FASTENERS make a strong, tight butt joint with long life. Recessed plates embed in belt, compress belt ends and prevent ply separation. Six sizes in steel and alloys.

● Avoid shutdowns and lengthen the life of your conveyor belts and bucket elevator belts by using Flexco belt fasteners. Thousands of companies have stepped up the performance of conveyor lines and cut costs by using Flexco methods.

Bulletin F-100 shows exactly how to make tight butt joints in conveyor belts with Flexco. Also illustrates step by step the latest practice in repairing rips and putting in patches.

Write for your copy.

FLEXIBLE STEEL LACING CO.
4656 Lexington St., Chicago

FLEXCO HD BELT FASTENERS

Sold by supply houses everywhere

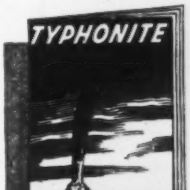
Blackout Wanted
in the drafting room!
DIXON'S ELDORADO HB

Eldorado makes perfect blackouts . . . *quick*

Eldorado's black line would shame a black cat for blackness! It's even, firm, opaque. That's because Eldorado is made by the exclusive *Typhonite* process which produces a lead as true and reliable as a U. S. Marine!

The smooth, perfect, opaque line you make with an Eldorado pencil is helping to win the war! Materials for Victory all start at the board. The cleanness of the line has all to do with the clearness of the blueprint. Insist upon *Typhonite* Eldorado.

Free Booklet
telling the interesting story of the Typhonite process and pencil-making. Please write on your professional or business stationery.



PENCIL SALES DEPARTMENT 227-J3 · JOSEPH DIXON CRUCIBLE CO. · JERSEY CITY, N. J.

FOR Victory Projects from ICELAND TO JAVA!

ROLAGRIP PIPE COUPLINGS

Save Vital Time and Labor

Contractors at home and in foreign lands are turning to Rolagrips because they permit "speed of lay" for pipes and because they make emergency piping immediately available. No special ends, threads or grooves required for leak-proof connections.

Installation Easy

Simply stretch gasket over pipe ends and bolt housings in place. For air, water, gas and oil lines.

★

G·B MFG. CO.

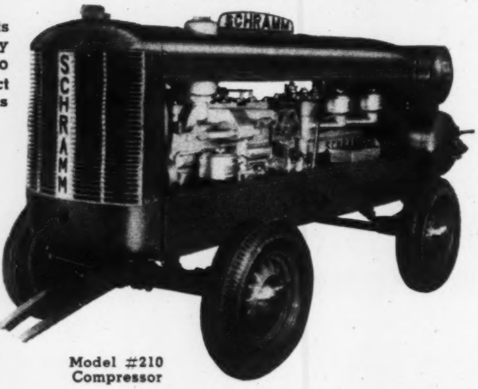
GUSTIN-BACON MFG. CO.
KANSAS CITY, MO.

TULSA
FT. WORTH
HOUSTON
NEW YORK
CHICAGO
SAN FRANCISCO

AIR for DEFENSE

A UNITED NATION puts its shoulder to the wheel. Every community is organized to further combat and protect its people from the "Agencies of Destruction."

The Contribution of SCHRAMM, Inc. to this tremendous Defense Plan consists of combinations of compressed air power for operating air and fire sirens — tools for demolition and rescue work — repair work on gas and water mains — electric, telephone and telegraph lines and railroad maintenance.



Model #210 Compressor

SCHRAMM, INC. is prepared to furnish air compressors that apply to every emergency requiring "AIR FOR DEFENSE."

Built in Sizes 20 To 420 Cu. Ft. Actual Air

WRITE FOR BULLETIN #4260

SCHRAMM, INC., West Chester, Pa.

fice at 1111 James Building; Chicago office at 323-325 East 23rd St.; Omaha, Neb., at 521 South 15th St. and Dayton, Ohio at 246 Wiltshire Blvd.

Stuart J. Saks has been made president of the **Morris Machine Works**, Baldwinsville, N. Y.

The DeVilbiss Co. has moved its St. Louis, Mo. sales and service branch to 2737 Washington Ave.

D. H. Lauder, for six years an engineer for **General Electric Co.** in Pittsburgh has been appointed assistant manager in General Electric's Schenectady, N. Y. contract service department.

H. M. Skelton, of Montreal, formerly sales manager of the fence division, the **Steel Company of Canada, Ltd.**, Montreal, has been appointed an industrial security inspector for the department of munitions and supplies of Canada.

Wallace G. Kileen has been appointed comptroller of the **Eastern Aircraft Division of General Motors**, according to a recent announcement. Mr. Kileen is a former assistant comptroller of General Motors in charge of the central office coast section in Detroit.

E. E. Aldous, formerly manager of sales for **United States Steel Corporation Subsidiaries**, at Houston, Tex., has been elected president of the **Scully Steel Products**, a U. S. Steel subsidiary. L. B. Worthington, has been elected vice president and director, and Charles B. Vernooy has been elected comptroller, secretary and director.

James Ely, 67, vice president of the **Taylor Instrument Company**, of Rochester, N. Y. died recently at his winter residence at Daytona Beach, Fla.

F. H. Dietrich, member of the firm of the **B. C. Equipment Co., Ltd.**, Vancouver has now been appointed a member of the staff of the Department of Munitions and Supply where he will be assistant to A. H. Williamson, controller of supplies. Mr. Dietrich was formerly factory representative for the **Traylor Engineering & Manufacturing Company**, Allentown, Pa.

Alan G. Wikoff, editor-in-chief of the General Publicity Department of **Union Carbide and Carbon Corp.**, New York, died at his home in White Plains, N. Y., Feb. 11.

M. E. Carlisle has been appointed general purchasing agent of the **Pittsburgh Plate Glass Co.**, succeeding J. A. Bechtel who recently retired after 50 years of service. Other changes in the purchasing department include the appoint-

ANNOUNCING . . .
the Bucyrus-Erie
Transit Crane

performance on wheels!

Designed exclusively for crane-excavator service from cab to tail light, from boom point to outriggers the new Transit Crane combines speed and dependability to meet the requirements of rush wartime jobs.

Hoist and swing speeds are synchronized to give a high-speed cycle. A fully independent boom hoist, giving power control of raising and lowering, permits extreme accuracy in load handling. Extra boom sections can easily be added or removed to fit boom length to the individual job. Open-throated boom permits easy rigging for multi-part lines. Field conversion from crane to clamshell, dragline, shovel or dragshovel is easy. The wheel mounting provides an all-welded base with maximum strength per pound of weight. Tandem rear axles mounted on an equalizer beam assure full traction over rough ground. Dual worm drive provides smooth application of power. Ten speeds forward and two reverse give a choice of speed-power combinations to fit a wide range of travel conditions.

There are a host of features that contribute to the outstanding performance of this fast-working, fast-moving crane. If you have work for a unit of this type, write for full details on the new Transit Crane.

2 MODELS AVAILABLE

22-B

Maximum crane rating, 40,000 pounds; travel speeds from 2 to 31 m. p. h.; ¾ yard clamshell, dragline, shovel and dragshovel.

15-B

Maximum crane rating, 20,000 pounds; travel speeds from 2.3 to 27.5 m. p. h.; ½ yard clamshell, dragline, shovel and dragshovel

Bucyrus-Erie

SOUTH MILWAUKEE, WISCONSIN

get TO the job FAST... get THRU the job FAST...

—with the Model 60

LE ROI

Portable Air Compressor

Here's a toughie that can take the punishment of today's fast working schedules. It has "the stuff" to lick 'em: *Speed* in set-up and starting. *Speed* and economy in operation. *Speed* and safety in moving. A 60 cu. ft. single-stage unit with both valve-in-head engine and compressor built by *one* manufacturer. Light in weight. Low in price. Operates two tampers or one paving breaker of average size, or other tools requiring similar quantities of air.

Get Le Roi's Model 60 for your next job.

C-8

★*Write for Bulletin 21G-1 for facts about the Model 60's "big-compressor" features.*

LE ROI COMPANY • Milwaukee, Wis.

VIBER COMPANY CONCRETE

VIBRATION

MOST PROFITABLE FOR ROAD SLAB WORK

Here's a new Viber Vibrator especially adapted to fireproofing steel members, floor slabs, shallow girders, concrete floor beams and joists, precast concrete products. You'll find it sturdily constructed, vibrates in concrete 9500 r.p.m., has ½ h.p. motor. Also ideal for highways and bridges—for vibrating concrete along pavement headers, expansion and construction joints, and making reinforced concrete piles at the bridge site.

Write for complete Viber data—TODAY!

VIBER COMPANY
726 SO. FLOWER STREET
BURBANK, CALIFORNIA

INSTALL FASTER... LOWER COSTS with

★ UNION ★

COMBINATION SLAB BOLSTER AND CONTINUOUS HI-CHAIR

Unit supported on 5" centers. Hi-Chairs a minimum of 2" high. Available in 5' or 10' lengths. Complies with Federal specifications.

Specify U. S. 573

Specialties

Hi-Chairs, Screed Chairs • Bar Spacers, Beam and Slab • Ceiling Inserts • Shelf Angle Supports • Bar Ties, Wall Ties • Reed Clip Beam Wrapping • Sleeper Anchors • Paving Joint Units

Wide variety of designs for special uses. Write for catalog. See Sweets, Sec. 3-52.

UNION STEEL
Products Company
417 Pine St.
ALBION, MICHIGAN

ment of Homer M. Hoffman, purchasing agent, Glass Division, and E. J. Peters, as purchasing agent, Paint Division.

The appointment of V. A. CHERN, 15 Gramercy Park South, New York City, as sales and service representative in the New York area for the PROGRESSIVE WELDER CO., of Detroit, has recently been announced.

The MISSOURI-ILLINOIS TRACTOR & EQUIPMENT CO., INC., of St. Louis, Mo., has been appointed distributor for BUCYRUS-ERIE shovels, draglines, clamshell and lifting cranes.

The MULLINS BODY & TANK CO. of Milwaukee, announces a change in the firm name to the MILWAUKEE WELDED PRODUCTS, INC., with no change in management or address.

L. C. RHODES, formerly district manager in the Spokane-Butts territory for the SULLIVAN MACHINERY CO., has been appointed manager of the company's Pacific coast territory.

GEORGE A. MATTISON, JR., of the WOODSTOCK SLAG CORP., Birmingham, Ala., was elected president of the National Slag Association at a meeting held recently in Washington, D. C. Other officers included FRED HUBBARD of the MIDLAND SLAG CO., Youngstown, Ohio, vice president.

JOHN W. ROSS of New York, has been elected a vice president, in charge of new business, of the WILLIAM L. CROW CONSTRUCTION CO., New York.

L. T. WILLISON has been appointed manager of ordnance sales, a newly created department, to handle all finished war material produced by the JONES & LAUGHLIN STEEL CORP.

R. M. MARBERRY, sales promotion manager of the TIMKEN SILENT AUTOMATIC DIVISION, has been appointed advertising manager of the TIMKEN-DETROIT AXLE CO. He will direct all advertising for TIMKEN axles and brakes, and for TIMKEN silent automatic oil heating products.

WALTER MOEHLENPAH has been appointed manager of the newly created FROSTRODE DIVISION of WELTRONIC CORP., Detroit. The Division will produce and market the new "Frostrode" industrial refrigerating units designed for use in combination with resistance welding equipment.

BENNETT BURGOON, JR., formerly mechanical engineer at the RAILWAY STEEL SPRING DIVISION of the AMERICAN LOCOMOTIVE CO., has been appointed new dis-

Why "FOREMANSHIP" Is Becoming 1942's Most Important Construction Handbook

Because: it is helping executives like yourself to select leaders among their men, whose characteristics and abilities properly qualify them for a Foreman's job . . .

Because: it is helping those responsible for the education of Foremen to train them more thoroughly and efficiently in classroom or group discussions . . .

Because: it is helping already experienced Foremen to simplify and improve their work, speed production, avoid accidents, conserve tools and materials . . .

Out of Your Industry, for Your Industry,

A Practical Manual That Helps Solve Today's Most Vital Problem

Written as a service to American Mutual's Contractor-Policyholders, "Foremanship" is the concise synthesis of years of experience with the problems of leadership on construction jobs. The men who wrote it — now American Mutual engineers — are not theorists, but men with a practical knowledge of construction superintendence. Their work has also been reviewed by superintendents now operating large construction contracts.

62 Fact-Filled Pages Concisely Cover the Essentials of a Foreman's Responsibility

The brief table of contents printed here will give you an idea of the scope of this volume, and how useful it will be, not only in the selection and training of Foremen, but also as a "refresher course" for your most valuable and experienced men. Send for it today! It will save time, save accidents and help you build the leadership on which efficient production depends.

Other American Mutual aids to profitable operations

Regular cash dividends which have always saved 20% or more of insurance costs (a big item in your operating costs).

Safety recommendations which have lowered many policyholders' rates well below average — as well as helping to avoid the delays and trouble that accidents cause.

Prompt service on claims and injuries wherever your contract may take you.

Modern, comprehensive coverage fitting your special needs for workmen's compensation, contractors' public liability, fire, automobile, fidelity bonds and other forms of casualty insurance written by American Mutual and affiliates.

Admitted Assets:	*$43,314,642.98*
Liabilities:	*36,505,925.33*
Surplus to Policyholders:	*6,808,717.65*

As of December 31, 1940

Chapter I

Foremanship — the foreman's responsibility to his job, to the superintendent, to his men, to his fellow foremen, to subcontractors and the general public; qualities which make for successful foremen . . 7

Chapter II

The Foreman's Place in Accident Prevention — planning for accident prevention; accident investigation; developing the accident prevention program 15

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The Foreman and His Men — selection and hiring, placing and training, supervisory methods 23

Chapter IV

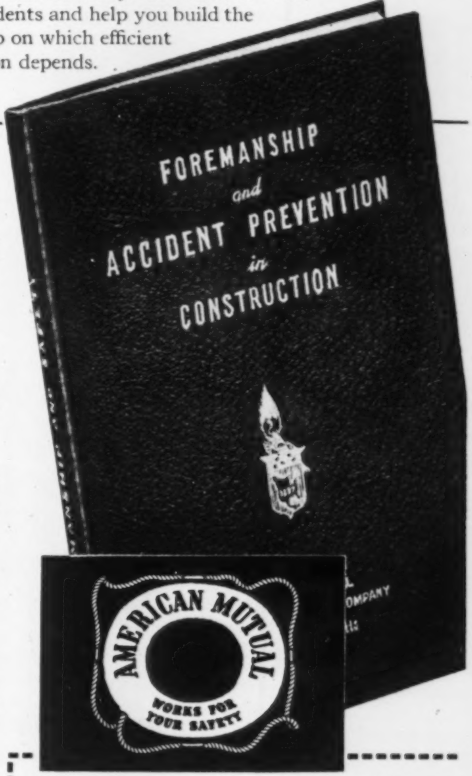
Job Planning — in relation to long range planning, layout of the job, receipt of materials, day-to-day plan 33

Chapter V

Physical Protection — excavation, staging and scaffolding, runways and platforms, barricades, overhead protection, clothing 41

Chapter VI

Care, Use and Storage of Equipment — principles of selection, testing and inspection; rigging, hand tools, supports, derricks, scaffolds, safe practice rules, machine operators, trucks, cranes, moving equipment, moving material, air equipment, machine guards, yard storage, tool storage 51



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Please send me FREE your book "Foremanship."

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THERE IS AN AMERICAN MUTUAL REPRESENTATIVE NEAR YOU

When you need Valves for SEWAGE Service

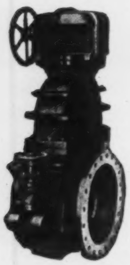
THE KENNEDY VALVE MFG. CO.

BACK-WATER AND SEWER-GAS VALVE

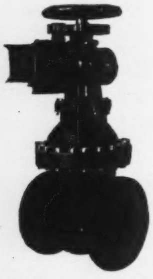
IRON-BODY POCKETLESS GATE VALVES

FOR SEWAGE TREATMENT PLANTS

. . . you will find all suitable types in the KENNEDY Catalog



Gear-operated Valve



Electric-operated Valve

Low-Pressure Outside Screw & Yoke Valve

Standard Non-Rising Stem Valve

Among the many Kennedy types of valves which are specially designed or adapted to sewage service are single dics pocketless gate valves, solid wedge and double disc parallel seat gate valves in a range of pressures, back water and sewer gas valves, and water gates.

For general plant service, too, on steam, water, air and gas lines, the 240-page Kennedy Catalog describes and lists many types of valves in bronze and iron body. Every water and sewage department engineer should have a copy of this informative catalog.

Write for your copy

THE KENNEDY VALVE MFG. CO.

Elmira, N. Y.

KENNEDY

VALVES *with Extra Value*

trict representative in western Illinois and Iowa by the McKENNA METALS Co., of Latrobe, Pa. He will make his headquarters at Rockford, Ill.

THE KAYDON ENGINEERING CORP. of Muskegon, Mich., manufacturers of special bearings and equipment has announced the appointment of L. J. Haga as chief metallurgist.

THE CANADIAN GENERAL ELECTRIC CO., LTD. has named R. N. Fournier of Toronto as specialist on industrial heating and welding electrodes and accessories.

PECAUT INDUSTRIAL SUPPLY CO., of Sioux City, Iowa, has been appointed distributor for REX construction machinery produced by the CHAIN BELT CO., Milwaukee, Wis.

THE TRI-STATE CULVERT AND MACHINERY CO., Atlanta, Ga., has been appointed distributor of EUCLID road machinery for Georgia.

D. J. BUTTLES has been appointed western manager at Salt Lake City, Utah for the CUMMINS ENGINE CO.

THE INTERNATIONAL FILTER CO., Chicago, has announced a change in its name to "INFILCO INCORPORATED." The company was organized 48 years ago.

The MIDWEST EQUIPMENT & SUPPLY CO., of Indianapolis, Ind., has been appointed representative for sections of Indiana for the RANSOME CONCRETE MACHINERY CO., of Dunellen, N. J.

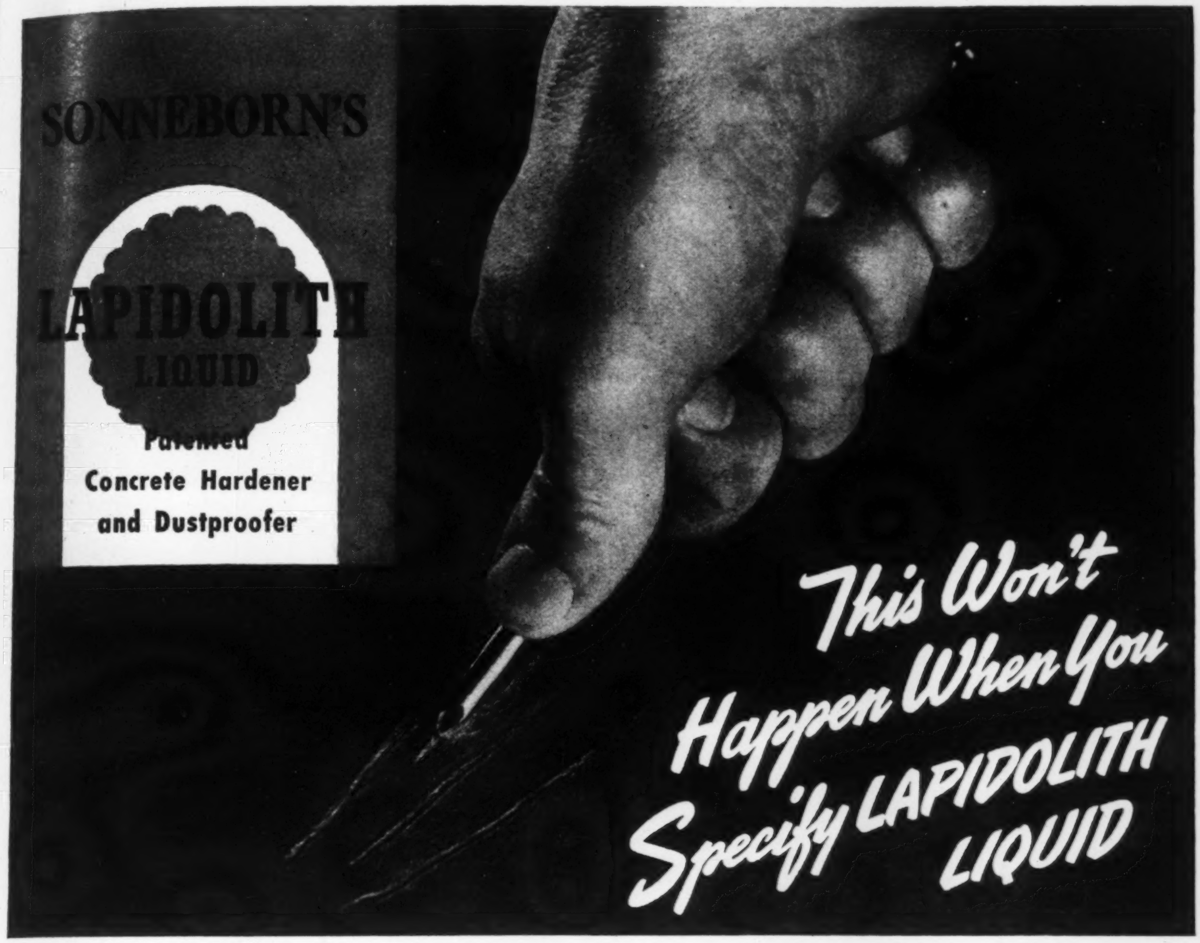
APPOINTMENT of H. F. Merchant as sales and service representative in the Philadelphia area, including eastern Pennsylvania, New Jersey, Delaware and Maryland has been announced by the PROGRESSIVE WELDER CO., of Detroit.

LEE J. GRATTAN has been appointed manager for the RAWLPLUG, MILWAUKEE CO., Milwaukee, Wis. This concern is a division of the RAWLPLUG CO., INC., in New York City.

NEWBOLD C. JONES has been elected president of the ONTARIO STEEL PRODUCTS CO., LTD.

PETER VOSS, since 1934 director of purchases for the TIMKEN ROLLER BEARING CO., of Canton, Ohio, recently announced his retirement after 24 years of active service.

CHANNING B. BROWN, of Charlotte, N. C., an official of the DUKE POWER CO., has been elected president of the North Carolina Society of Engineers. The annual winter meeting was held at Raleigh, North Carolina.



TODAY—more than ever, you have to be sure that the concrete floors in the building you are designing will stand up under heavy-duty use.

Once production begins, hours lost, whether due to the necessity of repairs or to the labor expended in keeping concrete floors dust-free—means money lost.

A twenty-five year performance record shows that a Lapidolized concrete floor is capable of withstanding the hardest punishment to which industrial floors are exposed.

The new patented features found only in Lapidolith assure even greater effectiveness—deeper penetration, and greater hardness.

Tests conducted in outside engineering laboratories amply demonstrate that Lapidolized concrete is more than twice as hard as untreated concrete.

Lapidolith Liquid is easy to apply and its use on new or old floors will not interfere with the occupation or use of a floor.

Write today for the free booklet, "Concrete & Lapidolith," with a Lapidolized sample which is suitable for a paperweight. It gives accurate, factual performance data. It shows why Lapidolith Liquid is the wisest choice for protecting old and new concrete floors.

Where Results Count—Count on Sonneborn

L. SONNEBORN SONS, Inc.

88 LEXINGTON AVENUE NEW YORK, N. Y.

The BLOWS THAT COUNT HEAVILY IN YOUR FAVOR IN PILE DRIVING . . . . .

Come from

SUPER-VULCAN OPEN-TYPE

DIFFERENTIAL-ACTING

PILE HAMMERS

18C, 30C, 50C, and 80C

The Super-Vulcan is giving valuable aid in speeding up construction in all parts of the country—they are making minutes count as "rush completion" continues to be the order of the day. You can expect the utmost in performance with the Super-Vulcan you purchase.

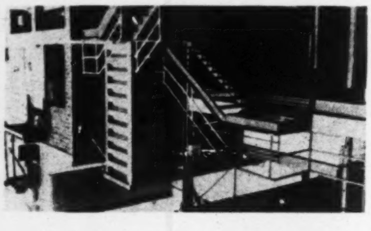
Here's how you benefit— you use 25% to 35% less steam per blow—you get twice the number of blows per minute — you drive more piles at less cost — you get easier operation, more dependable performance, and longer service. Fits the same leads and uses the same accessories as the Vulcan Single - Acting Pile Hammers. Write and get all the important facts.

SIZES
18C — 30C
50C — 80C
meet all needs

VULCAN IRON WORKS
Since 1852
331 North Bell Avenue
Chicago Illinois

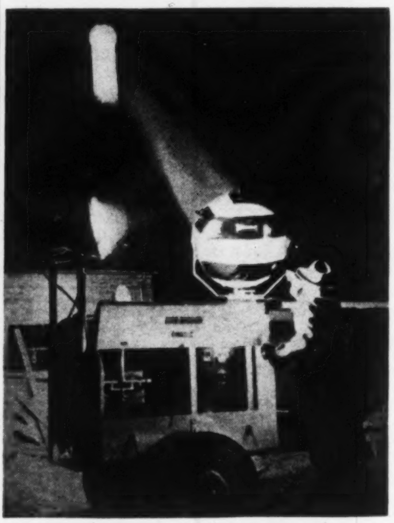
New Aids to the Constructor

Equipment and material announcements and manufacturers' news



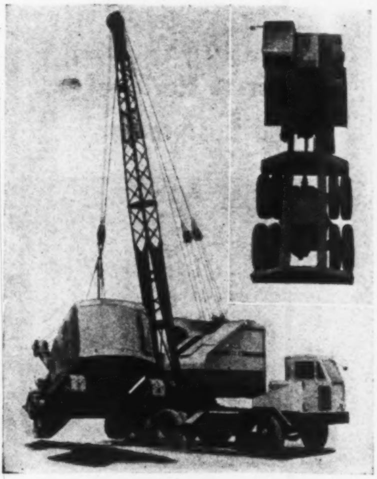
Bin Type Barricade Walls

A splinter protection method suggested by reports from battle fronts showing destruction of objectives on the ground has led to the advocacy of the use of bin type metal retaining walls arranged in various layouts. These walls, set vertically and to any height required, not only give ample protection against bomb splinters, but have the advantage of occupying a minimum of valuable space; they are quickly installed by unskilled labor, or dismantled and stored in a minimum of space. Literally, they are metal sandbags, but are much more permanent and otherwise advantageous. Metal barricade walls are not entirely a new idea. Hundreds of them have been installed at ordnance plants in this country to isolate any possible blasts and to protect adjoining buildings.—*Armco Drainage Products Association, Middletown, Ohio.*



Portable Searchlight Unit

Powerful, portable searchlight units, capable of throwing an effective beam of light for 1 mile, are now being manufactured by Lister-Blackstone, Inc., in addition to the company's regular floodlight machines. The searchlight model, called the "Nite-Hawk," is a fully self-contained source of light having a 24 in. searchlight with 3½ million candle power. Two 30,000 candle power wide-angle floodlights are also mounted for use as auxiliary or general lighting. The machine has been used for such varied purposes as laying long stretches of pipe at night, auxiliary and emergency lighting at airports, and mining and logging operations.—*Lister-Blackstone, Inc., Milwaukee, Wis.*



New 10- and 20-Ton Transit Cranes

Featuring unusual flexibility to meet an extremely wide range of job requirements and conditions, the 15-B and 22-B Bucyrus-Erie transit cranes just announced are not only fully convertible from crane to clamshell, dragline, shovel and dragshovel service, but are also designed for quick conversion from the wheel mounting to standard crawler mounting for occasional jobs inaccessible to wheel mounted units. Speed and mobility to shorten non-productive traveling time and step up output is provided by the rugged, specially designed ten wheel mounting. — *Bucyrus-Erie Co., South Milwaukee, Wis.*

Cement-Asbestos Pipe

"Roxite" is the trade name of the new line of cement-asbestos pipe now being offered by the United States Stoneware Co. Manufactured by a patented high pressure process, the pipe is said to have higher density and greater mechanical strength than other cement-asbestos pipe. Standard "Roxite" pipe is specially designed for the handling of a wide range of mildly corrosive solutions, for transporting processing water which must be kept free of metallic contamination, etc. The corrosion resistance of Roxite pipe also makes it most economical for handling fumes and gases in ventilating ducts

HIGH SPEED DUMPTOR HAULING

INCREASES PRODUCTION

in QUARRIES and OPEN PIT MINES

Now, when speed is essential, it is necessary to do the job in the shortest possible time. In quarries and open pit mines the Koehring Dumptor has been accepted as a high speed, dependable hauling unit. Important time-saving advantages are *instantaneous* dumping, three speeds, either forward or reverse, easy quick loading, G. M. Diesel power, constant mesh transmission. The Dumptor travels either way eliminating turns and backing. The Dumptor does not need to wait for body hoisting. It dumps by gravity, *instantaneously.* Seconds saved in every operation, increases daily production.

KOEHRING CO., *Milwaukee, Wis.*

Saves Seconds Every Trip

Koehring Dumptor dumps *Instantaneously* to cars, hopper, grizzly or fill.

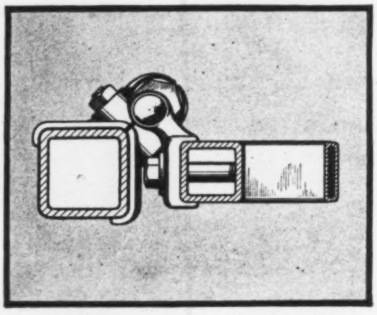
KOEHRING HEAVY DUTY

HEAVY-DUTY CONSTRUCTION EQUIPMENT

WHERE IT'S NEEDED MOST

Anchor Square Frame Gates

. . . always swing freely, latch easily, look more attractive, even after years of service. *Exclusive* Anchor construction of strong, 2-inch square steel tubing, inseparably butt-welded at *all* corners, provides amazing rigidity, freedom from sagging, warping. The fabric is firmly held by rounded steel tension rods. Single and Double types. Find out how Anchor Gates, and other exclusive Anchor features provide extra protection, durability, low maintenance cost. Write for Anchor Fence Industrial Catalog, and name of nearest Anchor Fence Engineer. ANCHOR POST FENCE CO., 6665 Eastern Avenue, Baltimore, Md.



Special Hinges permit 180° swing. Can be adjusted to open either in or out. Clamp to the gate. No holes to weaken the gate structure or to admit moisture.

1892 - 1942
Fifty Years of Service

Nation-Wide Sales
and Erecting Service

ANCHOR
FENCE

Approved "Dandux" Products

You can save and still buy *quality* Baskets when you specify *Dandux*. Precision craftsmanship and finer materials are your definite assurance of an extra measure of service and value in *Dandux* Products.

More than ever, today, we are prepared to do our part toward complete Victory.

C. R. DANIELS, INC.

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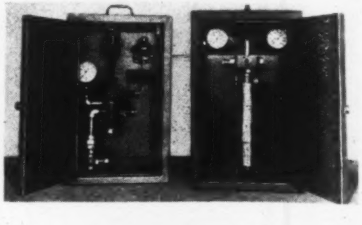
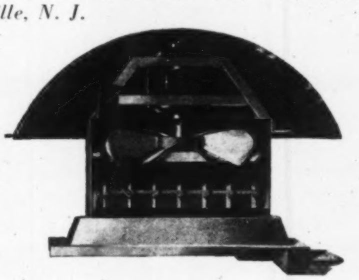
and stacks, by reducing maintenance costs or replacements to a minimum. For more severe duty, Roxite pipe is also available with an impregnated or synthetic coating which offers adequate protection for many types of highly corrosive conditions.—*United States Stoneware Co., 60 East 42nd St., New York.*



Portable Chlorinator

A new portable chlorinator unit designed to meet emergency calls quickly and efficiently, has just been introduced by Wallace & Tiernan Co., Inc. The new unit has continual usefulness at all times for dead-end flushing, main sterilization, and other chlorination needs away from the plant. Wherever a source of water at sufficient pressure to operate an injector is available, the new portable unit provides for a well diffused solution feed. Other conditions can be met by gas feed. —*Wallace & Tiernan Co., Inc., Belleville, N. J.*



Blackout Ventilators

Positive ventilation designed especially for blackout plants and for all buildings erected in the modern wartime blackout type of construction—buildings in which work must be carried on despite the possibility of air raids—has been developed by the Trane Co. The ventilators are light proof as well as weatherproof.—*The Trane Co., La Crosse, Wis.*

Machine Tool Lubrication

A marked development in the use of colloidal graphite for machine tool lubrication is reported by Acheson Colloids Corp. While machine tool manufacturers have long used this product for initial lubrication of machine beds, ways, cross slides, gibs, etc., to assist in reducing static friction when "breaking in" new machines, it is only recently that the lubrication practice has spread into the actual service lubrication of such equip-

"Greater Yardage, less maintenance expense – that sums up our experience with GULF PRODUCTS"

says highway contractor

W. H. Anderson, Asheville, N. C., is building a park-to-park highway near this city that involves the moving of 500,000 cubic yards of dirt and rock and the cutting of two tunnels. Gulf products are helping this contractor do a speedier, more profitable job.

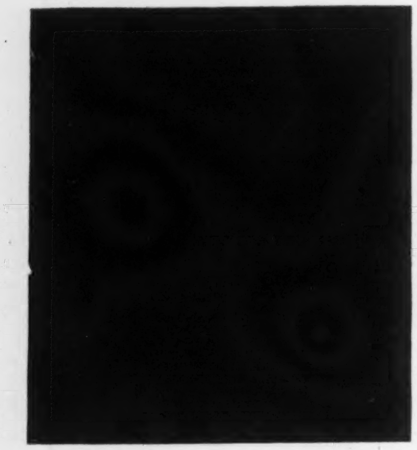
"OUR experience with Gulf higher quality lubricants and fuels proves their value on any kind of a road-building job," says the contractor on this highway project. "With Gulf products in service, we get efficient performance from our equipment and avoid mechanical delays—which add up to *greater yardage* and *less maintenance expense.*"

You, too, will find it *more profitable* to use Gulf quality lubricants and fuels on *your* next contract. Call in a Gulf engineer today and ask him to recommend the right product for each particular requirement. His recommendations are based on thorough training and broad experience gained through daily contacts with contractors' problems in the field. And his one big aim is to help insure a speedier job with low maintenance costs for your equipment.

No matter where your job is located, you are sure of quick delivery of Gulf quality lubricants and fuels through more than 1200 warehouses located in 30 states from Maine to New Mexico. Write or 'phone your nearest Gulf office today.

GULF

GULF OIL CORPORATION · GULF REFINING COMPANY · GULF BLDG., PITTSBURGH, PA.



Guard — YOUR WATER SUPPLY SYSTEM

Beware of sabotage! Remember, in an emergency, your water system may save highly valuable materials, buildings and even lives.

Neglect is almost as destructive as sabotage. If your water supply system is not in tip top order, call in Layne and have necessary repairing and reconditioning done at once. Materials, except for strictly war work, may not be available later. Maintaining present equipment is real conservation.

If you require more water, arrange for additional wells and pumps without delay. Better call in a Layne engineer. He will cooperate with you in planning your additional water supply so as to use the minimum amount of materials essential to war work, yet give you an adequate, efficient and long lived installation. Layne wells and pumps are designed for your requirements regardless of size. They are noted for their high efficiency and trouble free service. They are serving all types of industries, municipalities both large and small, army and navy needs, training camps, flying fields and munitions plants.

Write, wire or telephone for further facts.

LAYNE & BOWLER, INC.
Memphis, Tennessee

LAYNE
PUMPS & WELL
WATER SYSTEMS

Affiliated Companies

Layne-Arkansas Company	Stuttgart, Ark.
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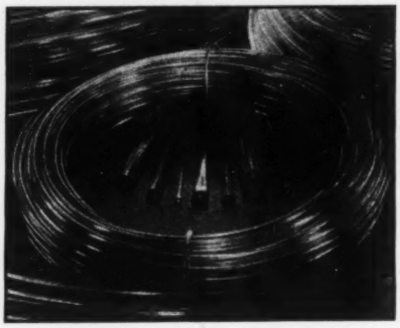
Layne-Western Company	Kansas City, Mo.
Layne-Western Co. of Minn.	Minneapolis, Minn.
Layne-Bowler New England Corp.	Boston, Mass.
International Water Supply, Ltd.	London, Ont.

ment. The particular characteristic of colloidal graphite which accounts for the development is that extremely fine particles of pure graphite are adsorbed by the metal surfaces under friction, forming a "graphoid" surface. The combination apparently provides a "dry" lubricating film which remains effective regardless of high loads imposed. Chatter, "stuttering," or irregular movement due to momentary failure of the lubricating film on machine beds, etc., is thus eliminated. In addition, the lowering of the values of static friction is responsible for a not inconsiderable reduction in machine friction.—*Acheson Colloids Corp., Fort Huron, Mich.*

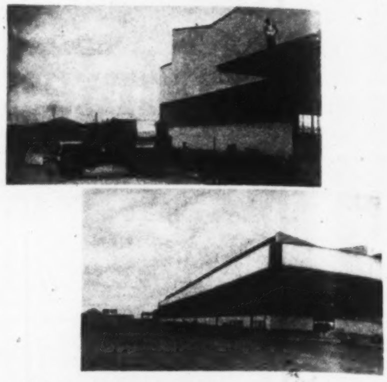
New Tractor Loader

For rehandling loose materials and moderate excavating, use of a shovel attached to the front end of industrial tractors is a popular and successful method. A new front-end loader for wheeled type tractors, being built by the White Manufacturing company, has an exclusive feature in an extensible boom with which the bucket is close up to the tractor front wheels when digging, but when the bucket is raised, it goes outward as well as upward and discharges two feet away from the tractor. This permits loading into the highest standard truck body and distribution of the material without hand spreading.—*White Manufacturing Company, Elkhart, Ind.*



Glass Tubing in Rolls

Transparent Tenite tubing in sizes ranging from $\frac{3}{16}$ to ¾ in. in diameter is now available for immediate delivery. It is a seamless tubing extruded in continuous lengths, and possesses many advantages not found in other type tubings.



AIRCRAFT FACTORY

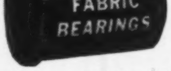
Big Bombers, for feeding concentrated hell to the Japs, are being built in this "GUNITED" factory located "somewhere east." The speed of construction made possible by the use of "GUNITE," is a large contribution to the nation's defense effort.

Our Bulletin #2200 illustrates and describes scores of profitable peace-time uses for "GUNITE," that architects, engineers and contractors should investigate.

The "CEMENT GUN" can be bought by anyone, and used without restrictions.

CEMENT GUN COMPANY
Manufacturers of the "CEMENT GUN"
ALLENTOWN, PENNSYLVANIA

WE ARE ALSO "GUNITE" CONTRACTORS
LET US BID ON YOUR WORK



Extra POWER
Extra SMOOTHNESS
Extra WEAR LIFE
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ASBESTOS
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AND FRICTIONS

Bring on your *TOUGH JOBS* — solving them is GATKE'S business.

Whatever your service, we have what it takes to do the job and will guarantee results.

Just tell us what you need.

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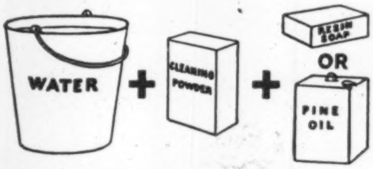
GATKE CORPORATION, 236 N. La Salle St., Chicago

How to increase the Life of your Oxy-Acetylene Welding and Cutting Hose . . .

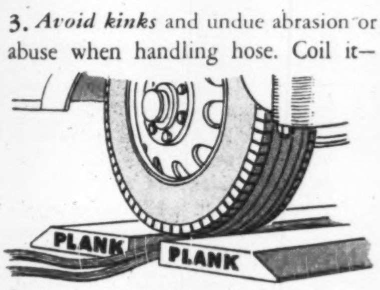
Uninterrupted use of the oxy-acetylene process is vital to industrial maintenance and production. It is therefore reasonable to expect the continued manufacture of adequate amounts of oxygen and acetylene hose for use in the many essential applications of this process. However — as with any product made of materials subject to strict rationing — certain limitations on manufacture of hose, and restrictions on sale, are inevitable. It is therefore to the advantage of everyone to increase the useful life of all oxygen and acetylene hose in service.

1. ***Protect hose from oil and grease,*** as these cause rapid deterioration of rubber. If oil or grease do get on hose, remove with water and any commonly used cleaning agent supplied in powder form, such as "Oakite;" or with concrete floor cleaning powder. Addition of about 5 per cent pine oil or resin soap will facilitate cleaning. Do not use gasoline, kerosene, or any cleaner containing caustic soda or potash.

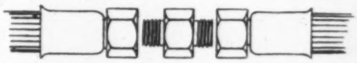


2. ***Avoid burning of hose*** due to careless use of blowpipes, or from permitting hose to contact hot objects.

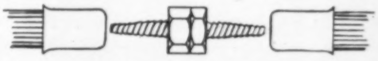
3. ***Avoid kinks*** and undue abrasion or abuse when handling hose. Coil it—don't drag it—when moving to new locations. If hose crosses the path of vehicles, protect it by planks.



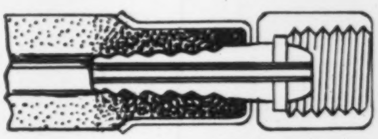
4. ***Use short lengths of hose.*** Short lengths not only are more readily available, but are more easily protected from damage. By inserting couplings in the ends of hose as illustrated, several short lengths can quickly be joined when required.



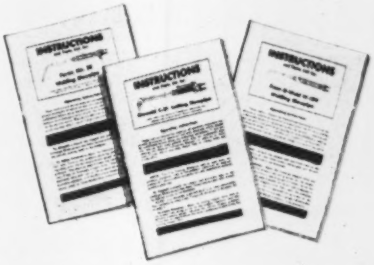
5. ***Test hose regularly over its full length*** by immersing it in water while under operating pressure. Cut out leaky sections at once and rejoin the hose ends by using hose splices as shown above.



6. ***Test all hose connections for leaks*** by brushing on soapy water while the hose is under operating pressure. If leaks are found—or if hose ends are worn—cut the ends off back to sound rubber and reassemble ferrules and nipples, as diagrammed above.



7. ***Operate blowpipes only at pressures recommended*** in the apparatus instruction book. Keep blowpipes in good condition to avoid damaging flashbacks. Use oxygen and acetylene hose only for the purpose for which each is intended.



8. ***Purchase hose only when actually needed.*** Rubber deteriorates while on the shelf, with resultant shortening of useful life.

* * *

Send for Helpful Literature

The steps described here not only will conserve hose, but will conserve gas and contribute to the safe use of the oxy-acetylene process. Duplicate copies of the instruction booklets furnished with apparatus supplied by Linde are available without cost upon request. Also available is the helpful booklet, "Precautions and Safe Practices", which gives full instructions for setting up apparatus correctly. Write for the copies you need—today.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
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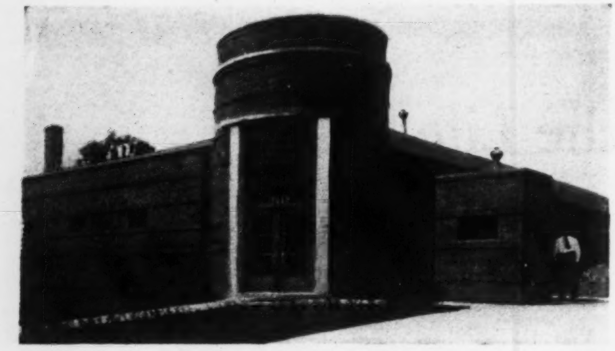
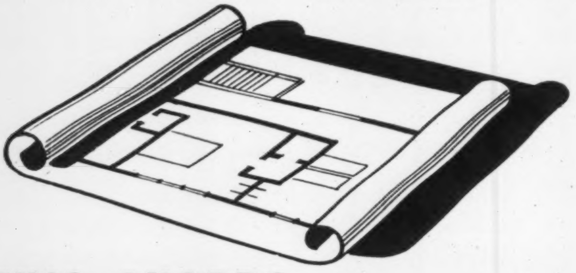
In Canada: Dominion Oxygen Company, Limited, Toronto

You Can Obtain Copies of this Advertisement For Distribution in Your Shops . . . or to Post on Your Bulletin Boards . . . Upon Request.



THIS GUARDS *blueprints*

To provide protection for the thousands of valuable blueprints entrusted in their hands by clients and the Government, the Pioneer Engineering & Manufacturing Company, Detroit, Engineering Consultants, have designed and built into their new building every precautionary measure against the saboteur and spy, as recommended by the Army, the Navy, and the Federal Bureau of Investigation.



THIS GUARDS *drawings*

But steel and concrete can't protect your important drawings from the ravages of time. Tracing cloths that turn brittle and opaque with age destroy thousands of dollars worth of drawings annually. Don't just *hope* this won't happen to you. Specify Arkwright on your next order for tracing cloth, and be *sure!* Sure of a tracing cloth that is clean, transparent, thin yet strong. More important – Arkwright Tracing Cloths *stay* this way. Insist on tracing cloths made by America's oldest manufacturer! Arkwright Finishing Co., Providence, Rhode Island.

Arkwright TRACING CLOTHS

"AMERICA'S OLDEST AND FINEST"

Sold by Leading Drawing Material Dealers Everywhere

STERLING QUALITY

STERLING PUMPS

YOU'LL GET BETTER RESULTS WITH STERLING

WRITE FOR LITERATURE

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405 13 Southwest Blvd., Kansas City, Mo

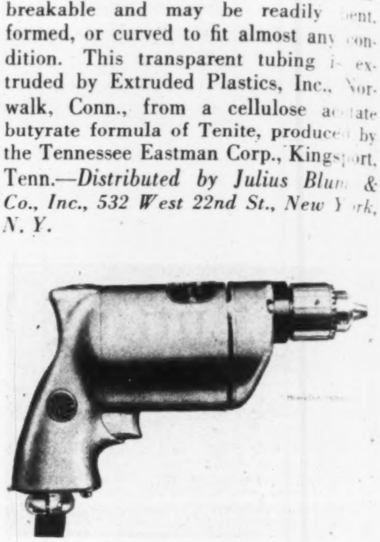
If "BUFF" makes it—it's a good Transit—proven and tried and true.

Rental Transits — Reasonable Rates. Send for handsome new catalog #491

BUFF & BUFF INSTITUTE
J. P., Boston, Mass.

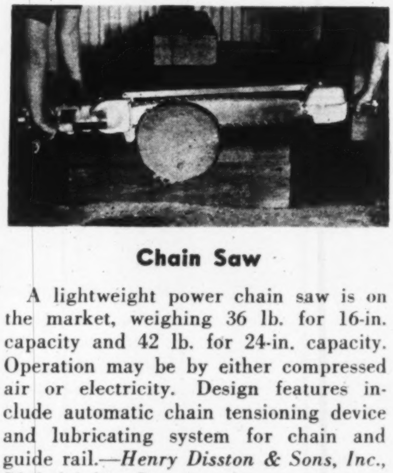
THE BUFF "X" TELESCOPE
has the finest and highest definition and simplest lens system. It is useful when the light is dim.

This new plastic tubing is virtually unbreakable and may be readily bent, formed, or curved to fit almost any condition. This transparent tubing is extruded by Extruded Plastics, Inc., Norwalk, Conn., from a cellulose acetate butyrate formula of Tenite, produced by the Tennessee Eastman Corp., Kingsport, Tenn.—*Distributed by Julius Blum & Co., Inc., 532 West 22nd St., New York, N. Y.*



Heavy Duty Drills

Black & Decker announced four new models of the heavy-duty Holgun, a $\frac{1}{4}$ in. drill especially engineered to the heavy production requirements of airplane and similar fabricating and assembly operations. The Holgun is offered in end and side handle heavy-duty models for standard or low speeds.—*Black & Decker, Towson, Md.*



Chain Saw

A lightweight power chain saw is on the market, weighing 36 lb. for 16-in. capacity and 42 lb. for 24-in. capacity. Operation may be by either compressed air or electricity. Design features include automatic chain tensioning device and lubricating system for chain and guide rail.—*Henry Disston & Sons, Inc., Philadelphia, Pa.*

Hauling Unit for Tournapull

In order to fully utilize the power and speed of the Super C Tournapull, the W210 Tournatrailer has been introduced with a heaped capacity of 17 cu.yd. This unit has flared sides and end walls to give the bowl an 8 ft. x 12 ft. 8 in. opening at the top for quick, accurate loading by big dragline or shovel. The W210 Tournatrailer is powered by the 150 hp. Super C Tournapull for fast pick-up and travel, quick spotting and maneuvering. Features of the big Tournatrailer are

FLOOD-LIGHTING BY KOHLER

Efficient KOHLER Electric Plants furnish unfailing light and power —when and where needed

• America has big jobs to finish, in fewer work hours, often with limited man-power — but with unlimited purpose. And Kohler Electric Plants are helping, at thousands of busy activity centers.

Kohler plants are compact, rugged, efficient. Quickly installed on dredges, excavators, drag lines, pavers and other portable equipment . . . easily movable on small trucks . . . essential for flood-lighting night work in bridge and road building, plant construction, oil-well drilling and all types of war production. Also, they supply ample power for operating motors, pumps, compressors and small tools.

Kohler plants are tested products — approved and improved over years of hard service under all conditions. They stand guard for emergency service, when regular current fails, in war plants, police departments, public utilities, hospitals and other vital centers. Thousands are in Government use — in virtually all branches of the service, on land and sea.

There are many models, types, sizes . . . 800 watts to 10 K.W. . . . A.C. or D.C. — hand cranked, remote control or fully automatic. Write for special information for contractors and engineers. Kohler Co., Dept. ENR-3G, Kohler, Wis.

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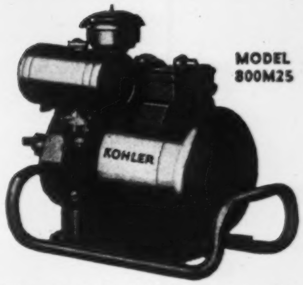
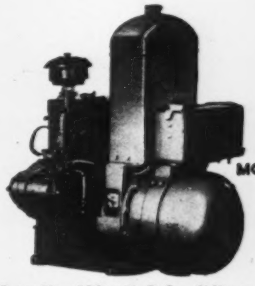
ELECTRIC PLANTS

PLANNED PLUMBING AND HEATING



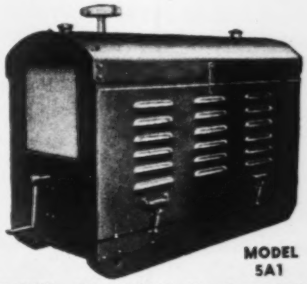
MODEL 800M25

800 watts, 115-volt A.C., hand cranked, with skid-type base and attached fuel tank for portable service. Also available fully automatic.



MODEL D

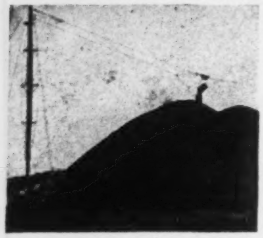
1500 watts, 110-volt D.C., fully automatic. Available hand cranked, with metal housing and skid-type base. Also in A.C. and 2000 watts D.C.



MODEL 5A1

5 K.W., 120-volt D.C., hand cranked, with metal housing and skid-type base. Also 10 K.W., 5 K.V.A., and 10 K.V.A., 60 cycle, A.C., fully automatic or remote control.

More Yards per Dollar



Sauerman Slackline Cableway dumping spoil onto high pile.

THOUSANDS of contractors have proved that Sauerman machines make easy work of many excavating problems that would be complicated and costly by any other method.

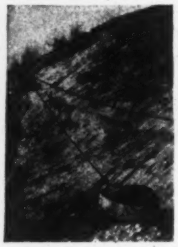
Wherever earth is to be moved any distance beyond the reach of a boom or dipper-stick, a Sauerman machine has an advantage because it is able to dig, haul and place the material in a straight-line operation, doing away with the expense of re-handling.

Sauerman Tower Excavator shown above offers large capacity in loading materials from pit or storage pile into cars or other conveyance.

The equipment investment generally is less, the operating expense always less—when a Sauerman machine is used for these long range jobs.

Tell us about your problem and we will offer our advice on equipment, also send you our catalog.

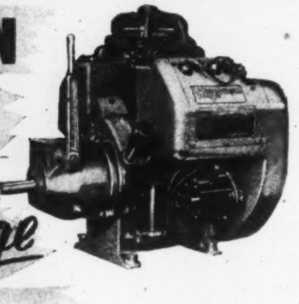
SAUERMAN BROS., INC.
532 S. Clinton St. CHICAGO



Small Sauerman Scraper offers an easy means of making a side-hill cut and fill for road.

Sauerman LONG RANGE MACHINES

WISCONSIN HEAVY-DUTY Air-Cooled ENGINES Come of Age



Model VE-4
22 hp., 4 cylinder, V-type Engine. Other types and sizes: 1 and 4 cylinder, 1 to 35 hp.

"Old enough to vote", in terms of continuous production and development, Wisconsin heavy-duty air-cooled engines have also definitely come of age from the standpoints of industrial recognition and acceptance.

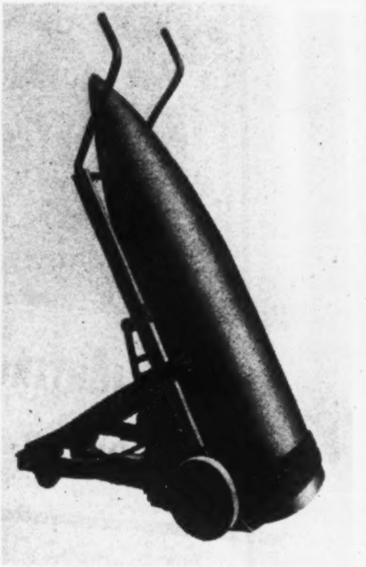
It has taken the hard proof of service, under the most trying operating conditions, in many lines of industry and power applications . . . to convince designing engineers, equipment manufacturers, and tough-skinned users that AIR-COOLED ENGINES, properly designed and built, *cause less trouble and provide higher productive capacity* than any other type of internal combustion unit within 35 hp. limits.

More than 300 machine manufacturers use Wisconsin Heavy-Duty Air-Cooled Engines as standard power equipment . . . covering your field as well as many others.

MOST POWER Per POUND

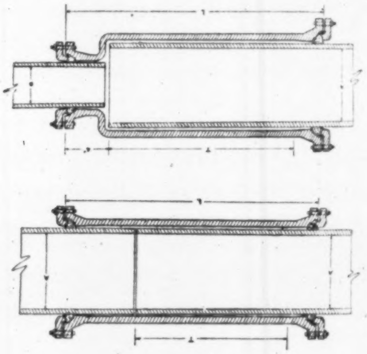
WISCONSIN MOTOR Corporation
MILWAUKEE, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

self-cleaning, sliding bowl that gives end-dumping or spreading in layers from 1 to 36 in.; 21-in. external hydraulic brakes, cable-operated double-drum power control unit; and is interchangeable with the LP Carryall.—*R. G. LeTourneau, Peoria, Ill.*



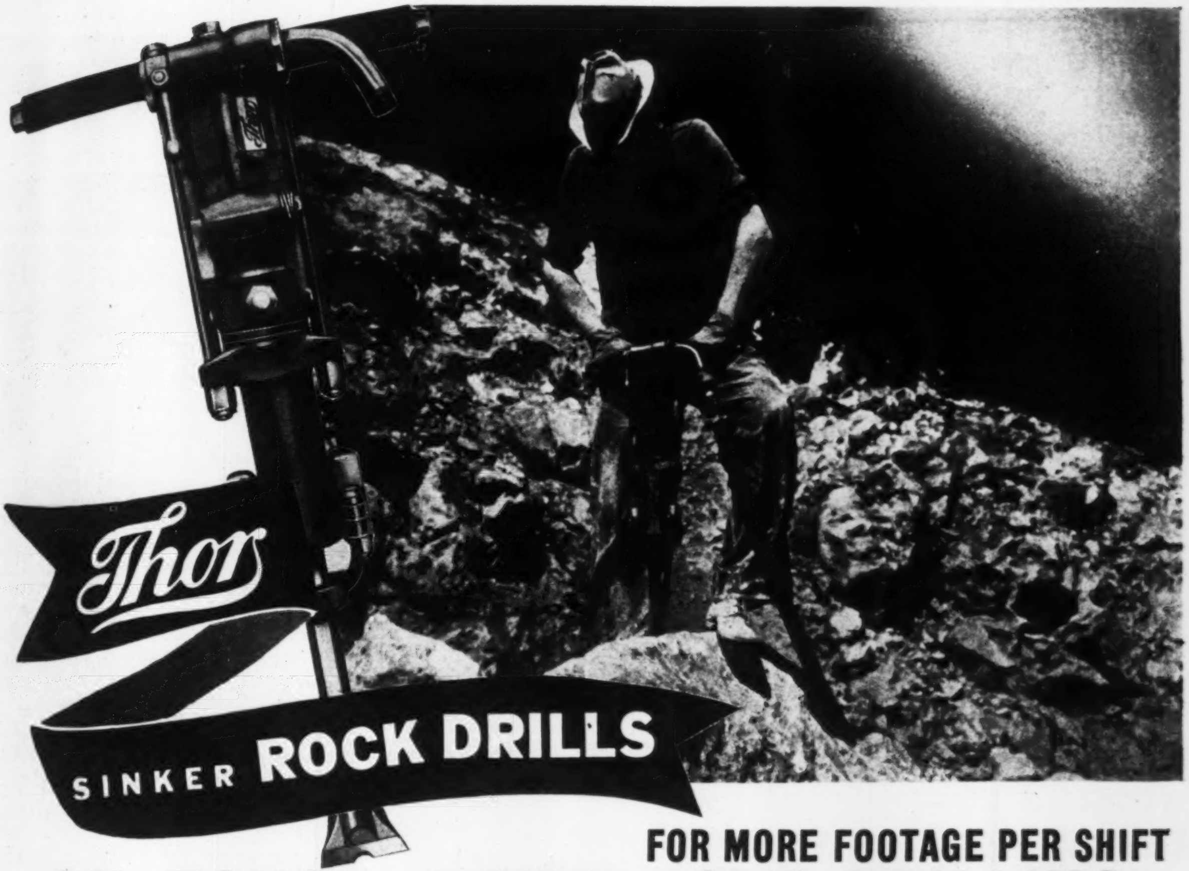
Hydraulic-Release Shell Truck

The Lewis-Shepard Sales Corp. announces the development of a hydraulic-release shell truck, developed for the safe, quick and easy handling of large shells in munitions plants. The truck is designed so that the load pivots around a point near its center of gravity. This keeps the load in balance so that one man can easily raise or lower it. The truck is equipped with a gentle-action hydraulic release check which further cushions the movement of the load.—*Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass.*



Cast Iron Sleeves

Development of cast iron sleeves designed specifically for the repair of water mains broken by bombing is announced by the American Cast Iron Pipe Co. The new development is being submitted



FOR MORE FOOTAGE PER SHIFT
ON TOUGH, DOWN-HOLE DRILLING

Thor Sinker Rock Drills in every weight class have an *extra* margin of power that means the difference between ordinary and *outstanding* footage on down-hole rock drilling. They hit hard and fast because they actually use most effectively ALL of the air that enters the machines. Basic reason for this is the patented Thor short-travel, tubular valve (with a controlled tolerance of .00025") that measures and admits exactly the right amount of air for peak operating efficiency.

Positive Control — High Average Drilling Speed

Thor's precision valve action, *plus* a quick-acting throttle valve, gives drill runners positive control for all operating conditions. This means powerful rotation for hole starting with quick acceleration to top speed for drilling and plenty of air for clean hole blowing. Results — high average drilling speed and *more* holes per shift.

Easy Holding — Sturdy Construction

Just as Thor's principle of "Measured Air" assures full efficiency and control, so also does it provide easy handling. With every stroke powered by the same amount of air, operation is smooth and uniform. Naturally, minimum vibration contributes to longer life, as do the air-cushioned retainer, automatic lubrication and drop-forged steel construction. Today, on scores of road building, shaft-sinking, tunnelling and other projects Thor Rock Drills are delivering more footage per shift.

A THOR SINKER ROCK DRILL FOR EVERY DRILLING JOB

7 standard models for light, medium or heavy duty work in the most popular weight classes. Other types available for special applications.

MODEL NO.	TYPE OF SERVICE	WEIGHT CLASS
38	Light Duty	45 Lb.
39	Auger Drill	45 Lb.
70 Series	Medium Duty	55 Lb.
85-B	Heavy Duty	80 Lb.

For All Your Portable Tool Needs — ROCK DRILLS, PAVING BREAKERS, SHEETING DRIVERS, CLAY DIGGERS, BACK FILL TAMPERS, SPIKE DRIVERS, CONCRETE SURFACERS, SAWS, HAMMERS, DRILL STEELS, DETACHABLE BITS, HOSE AND HOSE FITTINGS

Thor *Portable Pneumatic and Electric Tools*

INDEPENDENT PNEUMATIC TOOL COMPANY

600 W. JACKSON BOULEVARD, CHICAGO, ILL.
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CORLAP

. . . COMMERCIAL'S HIGH SECTION MODULUS LINER PLATE WITH THE HIGH JOINT EFFICIENCY!

Among the many types and sizes of Tunnel Liner Plates and Supports which COMMERCIAL has developed, and manufactures, CORLAP represents the ultimate in *faster, safer, stronger* tunnel lining methods! It's a high section modulus plate, with embossed bolt holes that assure highest joint efficiency. Since its recent introduction, CORLAP has achieved an enviable record on numerous, varied size tunnel jobs.

Get the facts on CORLAP prior to tunnel plate recommendations . . . also on the many other COMMERCIAL Plates and Supports. Knowledge of COMMERCIAL products can save you time and money on every shaft or tunneling project—write for complete details today!

THE COMMERCIAL SHEARING & STAMPING CO.
YOUNGSTOWN . . . . OHIO

Sterling Made Good on this "One-Track" Idea— Quality

Starting here in 1904, the Sterling Wheelbarrow Quality-Idea Tripled to this in 1907 ...Tripled again in 1910; *and* today leads the world in this Greatest of all Wheelbarrow Plants —

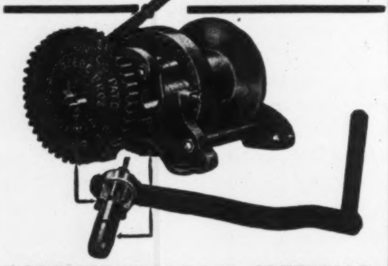
YOU KNOW Sterling QUALITY PAYS!

STERLING WHEELBARROW CO., MILWAUKEE, WIS.

Sterling S

Look for this Mark of STERLING Quality

WHEELBARROWS



Compact! Powerful! Safe!

DISTRIBUTABLE CONTROLLED POWER

with Beebe Bros ALL STEEL HAND HOIST
SEATTLE, U.S.A.
TRADE MARK REGISTERED

★

Money Has Been Saved on These Jobs

1200' assembled pipe (132 Tons) were lowered to bed of Mississippi at St. Paul with 9—5-Ton Beebes, three lines to each hoist through blocks.
Hudson River Bridge sidewalks were laid iin sections with 32—5-Ton Beebes.
Longest wooden trusses in world were iinstalled with ONE 5-Ton Beebe after power hoists proved impractical.

★

When raising, lowering, or placing costs by power are a serious problem, the answer is the right number of Beebe Bros. All Steel Hand Hoists MANNED IN UNISON. Available in 2, 5 and 15 Ton sizes. Sold through leading dealers in all trade centers. List of dealers sent upon request.

BEEBE BROS., 2720 6th Ave. S., Seattle, U.S.A

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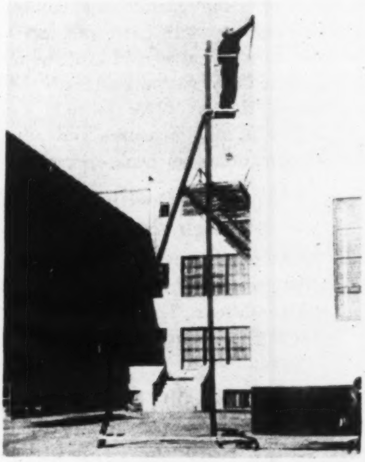
"THE STRONGEST GEARED POWER FOR ITS WEIGHT IN THE WORLD"

to representative customers, and as soon as these have submited their reactions, the product will be offered to the trade.—*American Cast Iron Pipe Co., Birmingham, Ala.*

Light-Weight Pumps

The Rex Junior is a light-weight, 3,000-gal.-per-hr. centrifugal pump weighing only 57 lb. This 1½-in. pump has all the engineering features of the standard line of Rex centrifugal pumps, including the famous "peeler," a device that actually peels the air from the whirling impeller and thus speeds up the prime. It has a large semi-steel recirculating water chamber and is powered by dependable, easy starting single cylinder, air-cooled engine of 1 hp. This machine was designed primarily for the contractor but has been found to fill the needs of utility companies and others.—*Chain Belt Co., Milwaukee, Wis.*



Safety Elevator Scaffold

A man can erect the safety scaffold shown above in two minutes and can then safely work from it, using both hands, at any height to 17 ft. Designed for a 200 lb. working load, it is mounted on four rubber tired casters on a wide and stable base. It can be set to hold stationary or may be moved by the man

Push the tough jobs through *on Schedule*

HEIL HI-SPEED CABLE SCOOPS — Complete dirtmoving units consisting of 150 H. P. Heil Rubber Tired Tractor and 15-yard Capacity Heil Twin-Cable Scoop. Designed for high speed operations with hauling speeds up to 20 M.P.H. depending on road and grade conditions.

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A Complete Line of Dependable Earthmoving Equipment to Help You Maintain High Speed Operating Schedules.

Today's high speed production schedules call for heavy duty construction equipment that will stand up under a punishing day-and-night work program. Speed and more speed is the order of the day — no matter how big the job or how tough the operating conditions may be. That's why it's important for you to have equipment that can be depended on to see your job through 'on time' without delays and service expense.

Heil Road Machinery is built by a pioneer manufacturer of construction equipment and is designed by experts to give you efficient, dependable operation on all types of jobs. Heil offers you a complete line of earthmoving equipment to choose from. You will find the *right* equipment for *your* job in the complete line of Heil Hi-Speed Tractor-Scoops, Heil Twin-Cable Scoops, Heil Trailbuilders and Bulldozers, Heil Hydraulic Dump Units, and Heil Tamping Rollers. See your nearest Heil Distributor or send for illustrated catalog today . . . Address:

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HEIL TWIN-CABLE SCOOPS — Fast operating economical Heil Twin-Cable Scoops are built in 6, 8, 10, 15, 18 and 25-yard capacities, for operation with all makes of crawler tractors. Specify Heil Cable Scrapers to insure trouble-free operation and lower cable replacement costs, regardless of the tractors you use.

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HEIL HYDRAULIC DUMP UNITS — Heavy duty Heil dump bodies and Heil Hydraulic Hoists are available in suitable capacities for mounting on any truck chassis. See your nearest Heil Distributor for recommendations.

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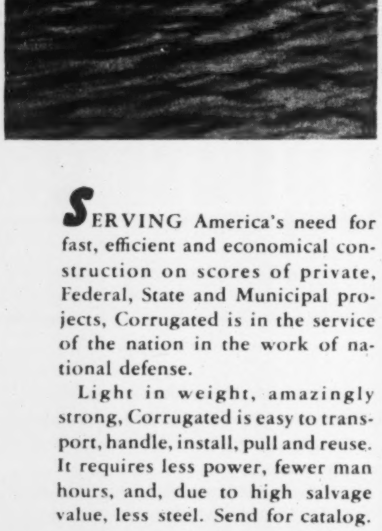
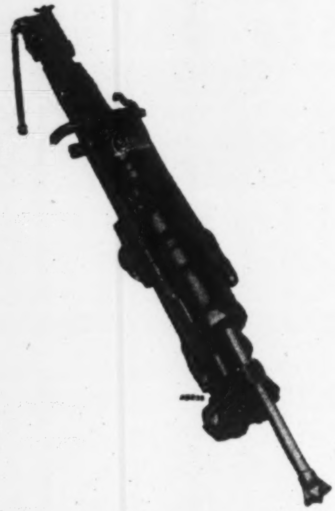


CORRUGATED
STEEL SHEET PILING

on the scaffold. The user stands close to the work, and is relieved of strain, fatigue and danger, increasing efficiency and production.—*R. W. Fieroh Co., Inc., 3401 South Hoyne Ave., Chicago, Ill.*



Improved Rock Drill

The D-505 drifter is the latest addition to the Ingersoll-Rand group of rock drills. Incorporating many new and improved features, the drill is said to be the most durable drifter ever produced by the company. Exhaustive tests show that the efficiency of the D-505, based on inches drilled per cubic foot of air at 90 lb. pressure, is 34 percent greater than that of previous 4-in. bore machines, and 52 percent greater at 70 lb. pressure. Improvements in the wall section of the fronthead, the shank aligner and chuck design contribute to the ruggedness of the instrument. Air to the front end of the cylinder passes directly between the ratchet and the head of the rifle bar. It is unrestricted by small ports, thus assuring good hole cleaning, and aiding in supplying constant lubrication to all moving parts.—*The Ingersoll-Rand Co., Phillipsburg, N. J.*

New Asphalt Center Strip

A new center strip for longitudinal and contraction joints in concrete highway and airport runway construction, fabricated from asphalt mastic board, has been announced by Keystone Asphalt Products Co. Introduced at a time when steel is urgently needed for armament, the product is offered in designs conforming to current standards, and is supplied in any required lengths and with desired punching for dowel pins and stake holes. It is not offered as a substitute for steel center strips, but as a product designed to serve the construc-

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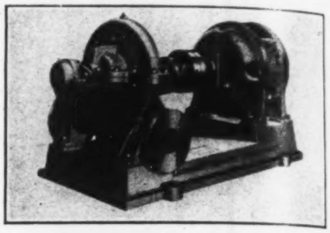

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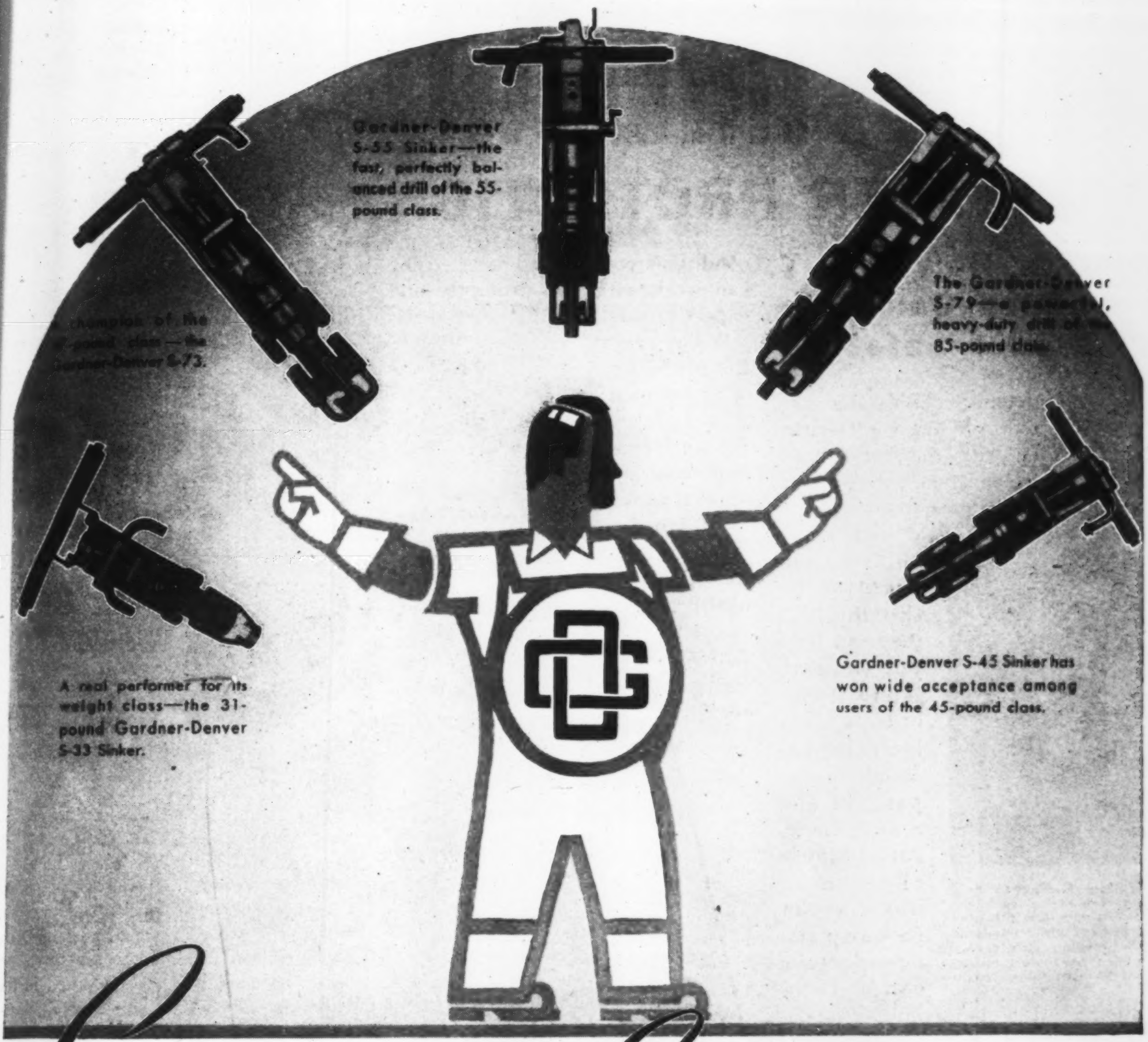
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champion of the [illegible]-pound class — the Gardner-Denver S-73.
The Gardner-Denver S-79—a powerful, heavy-duty drill of the 85-pound class.
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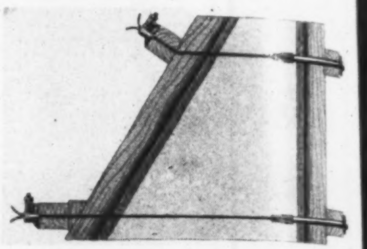
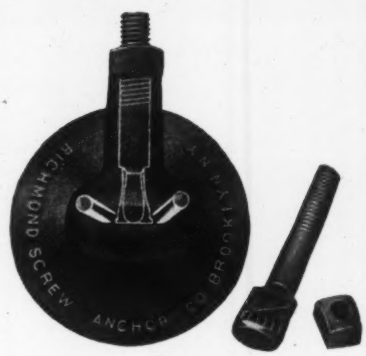
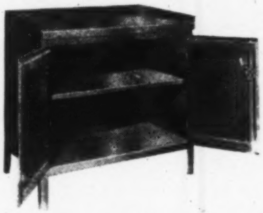
tion industry as longitudinal and contraction joints not only during, but also after the war.—*Keystone Asphalt Products Co., 43 E. Ohio St., Chicago, Ill*





Form Tie

Richmond has added the Flex-Ty to their varied line of concrete form tying devices. Flex-Ties, short name for flexibility, are made from very strong cold drawn wire assuring guaranteed strength. One end of the tie has a preformed helix (wire coil nut) welded to the two strut wires. Richmond Tylags' are used in the helix end of the tie while the two wires on the free end of the tie are engaged in the Flex-Ty clamp. The clamp is specially constructed with a hardened wedge shaped bolt the head of which rests against the two wires when the nut is drawn up tight. This tie is ideal where walls are of varying thicknesses and for walls of circular or sloping shape. —*Richmond Screw Anchor Co., Inc., 816*



Steel Work Bench

Lyon heavy duty steel work benches are given a more diversified use by addition of several new and improved accessories. The basic steel bench may be equipped with a single drawer, two or three shift drawer units for multiple shift operations, half depth shelf, full depth shelf, back

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ON WATER PROTECTION

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The full advantages of a water supply protected by Wallace & Tiernan chlorinators, with the backing of W&T service assistance, were never greater than they are today.

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This new emergency chlorination trailer uses the W&T vacuum principle in a new rugged-service construction. Provides self-powered solution feed up to 300 lb. chlorine per day.

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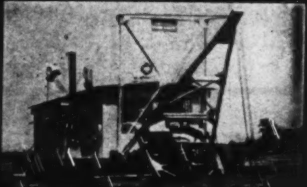

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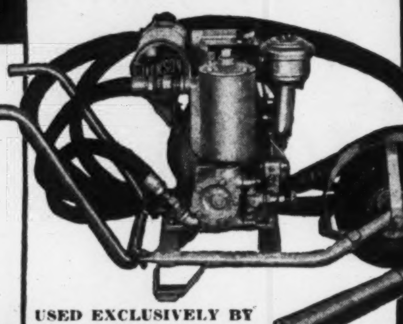

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and end stops, foot rest, or full length bench riser. The channel type stringer illustrated is used only when bench has no shelf.—*Lyon Metal Products, Inc., Clark St., Aurora, Ill.*

Tap Reconditioner

Designed to alleviate current difficulties in securing the vast numbers of precision ground taps required for war production needs, a tap reconditioner is announced by Detroit Tap & Tool Co. Combining in one unit facilities for chamfering, for spiral pointing and for point polishing, the tap reconditioner serves to eliminate delays in tap replacements by simplifying reconditioning.—*Detroit Tap & Tool Co., 8432 Butler St., Detroit.*

Barrel Carrier

A new Little Giant drum and barrel carrier, with capacity up to 600 lb., is on the market, said to take the place of several men formerly required to break-over, balance and move drums. All accidents common to handling loaded containers are prevented by the simple lifting device and self-balancing tri-wheel design built into these carriers.—*Ernest Magic Carrier Sales Co., 1456 Jefferson Ave., Buffalo, N. Y.*

Safe Stamping Holders

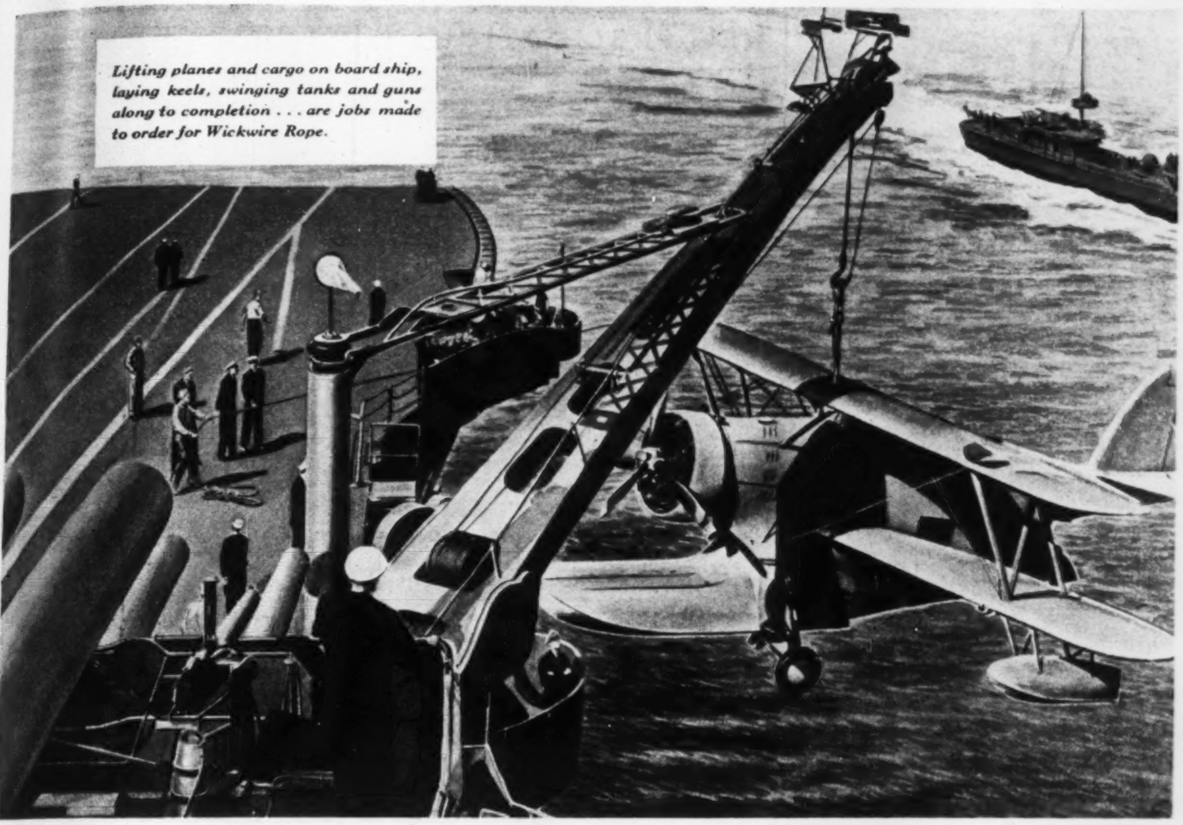
A new steel stamp holding device, developed primarily for safety in hammer struck stamp impressions on steel products, has been developed by James H. Mathews & Co. It is claimed that better stamping is encouraged with this device because the workmen need not fear bruised fingers caused by flying stamps, struck by glancing blows. The stamp holder can be used for stamping round or flat products.—*James H. Mathews & Co., Pittsburgh, Pa.*

New Rust Inhibitor for Black Iron

The Watson-Standard Co., has announced the development of a new organic coating for black iron which may be applied economically at the steel mill and is expected to result in the solution of many coating problems. The new coating would be used as a protection in lieu of the oil previously used on metal. It is of oxidizing type providing protection against corrosion and serves as a prime coat for all types of synthetic and oleo-resinous coatings.—*Watson-Standard Co., Pittsburgh, Pa.*

New Heavy Duty Jack

An improved heavy duty "all purpose" automatic lowering ratchet type jack has recently been placed on the market by the Buda Co. It is specially designed for heavy duty and outside work such as is found in the oil fields, construction jobs, and utilities.—*The Buda Co., Harvey, Ill.*



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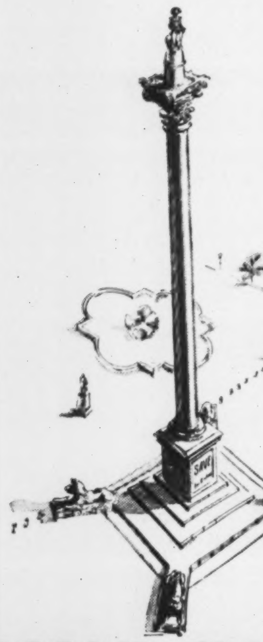

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NEW PUBLICATIONS

New Publications listed will generally be sent gratis to those requesting them on stationery of companies engaged in the work they refer to. Requests of others, or for more than one copy, should be briefly explained. Address requests directly to the manufacturer.—Editor.

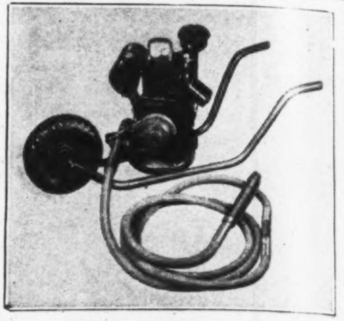
Metal Lath—Printed copies of Simplified Practice Recommendation R3-41, Metal Lath (expanded and sheet), are now available. This simplification program lists the weights of stock types of flat, flat-rib, ⅜-in. rib, and ¾-in. rib expanded metal lath, and of sheet lath; also stock sizes of cold-rolled channels and small-nose corner beads. The channels and corner beads are included for the first time.—*Superintendent of Documents, Government Printing Office, Washington, D. C.*

Vocational Guidance—A new vocational guidance booklet on engineering, intended for the use of high school students and their advisors, has just been published by the Engineers' Council for Professional Development, joint agency of eight national engineering organizations. Entitled "Engineering as a Career," the booklet is planned to help students decide whether they are fitted for the profession by giving them a general picture of the characteristics and requirements common to all branches of the profession.—*Engineers' Council for Professional Development, 29 West 39th St., New York City.*

Drum Carriers—A new bulletin giving the complete story of operating, construction and application features of the Ernst drum and barrel carrier has just been issued by the manufacturer.—*Ernst Magic Carrier Sales Co., 1456 Jefferson Ave., Buffalo, N. Y.*

Expansion Joints—A new 14-page illustrated bulletin is available on the Adsco piston-ring type, Model A expansion joint, which can be unpacked and repacked under full operating pressure without interruption to service. Details of construction, dimensions, specifications, etc., are given in the bulletin on this joint.—*American District Steam Co., North Tonawanda, N. Y.*

Scrapers—A new complete equipment booklet describing the earth moving, land clearing and snow removal equipment manufactured by the LaPlant-Choate Mfg. Co., has just been released. Each model is described generally, with explanations as to size and capacity. Sections are devoted to cable-operated scrapers, ranging in size from 12 to 33 cu.yd.; to hydraulically operated scrapers of 3.8



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Master Equipment is competitive in price and is built of the very highest quality of material and workmanship and gives the utmost in performance with long life and uninterrupted service in the use of same.

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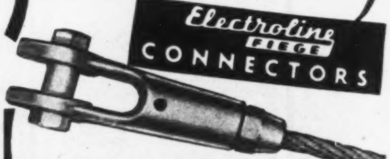
BECAUSE they have a special grip, Electroline-Fiege Wire Rope Connectors "hang on" under all conditions. The bite is tapered from rear to front. That dampens vibrations, thus preventing crystallization and fraying, gives you a positive connection and added rope life.

Electroline-Fiege connectors are safe (no molten metals to injure workmen or weaken wire rope,) streamlined, easy to install and economical. There are styles and sizes to fit every need. Write today for the interesting booklet, "Positive Grip". It is full of useful data.

Electroline FIEGE CONNECTORS



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to 8.2 yd., and the new CW-10 "Carrimor" 10 cu.yd. scrapers.—*LaPlant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa.*

Pipe Tools—A 28-page catalog covering the complete line of portable pipe and bolt cutting and threading machines; portable pipe and bolt cutting and threading power drives and power units; pipe cutting and threading tools, 1/8 to 12-in.; pipe reamers, etc., has been issued by the Beaver Pipe Tools, Inc.—*Beaver Pipe Tools, Inc., Warren, Ohio.*

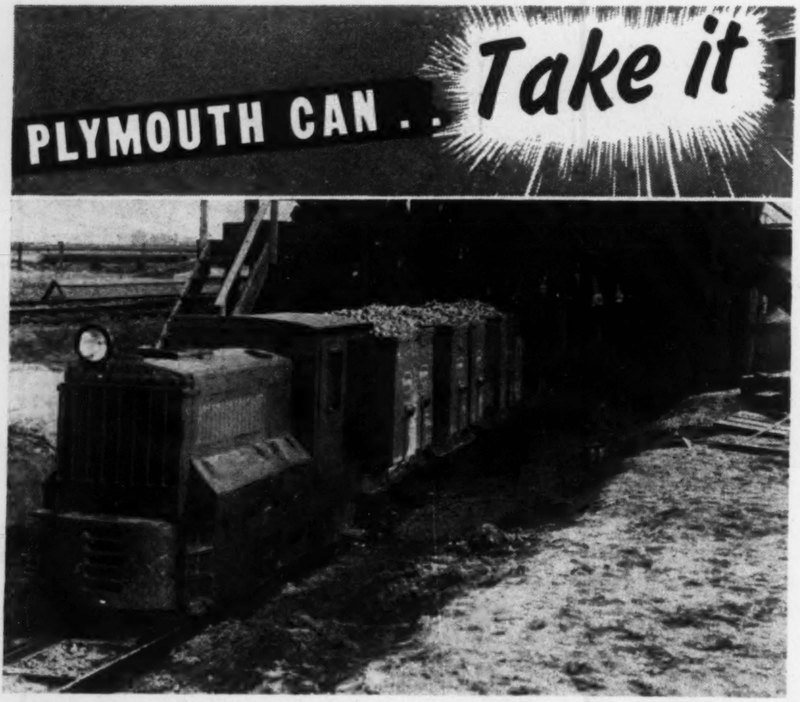
Pumps—A three-color, four-page folder illustrating the use of Peerless pumps on the new $70,000,000 Pennsylvania Turnpike, has just been issued by the Peerless Pump Division, Road Machinery Corp.—*Peerless Pump Division, Food Machinery Corp., 405 So. 4th St., Minneapolis, Minn.*

Glass Design Data—By concentrating the contents of a new booklet "Glass and Its Adaptability to Modern Needs," on just two types of information, physical properties and suggested applications, the Pittsburgh Plate Glass Co., Pittsburgh, Pa., has done the busy engineer and architect a useful service. All types of flat glass products are covered, and glass block and foam insulation as well. *Pittsburgh Plate Glass Co., Pittsburgh, Pa.*

Getting Work—"How Small Industries can go after War Work," is the title of an illustrated booklet published by the Copper and Brass Research Association. Purpose of the booklet is to show small companies how to get contracts or subcontracts through the Contract Distribution Branch, Production Division, War Production Board, at Washington, D. C., or through Regional Offices. The booklet contains information on securing of loans for equipment, forming of pools to obtain contracts and other helpful matter.—*Copper and Brass Research Association, 42 Lexington Ave., New York.*

Heaters—A new bulletin describing Carrier "Five-Way Unit Heaters" has been published by Carrier Corporation. The heaters, which get their name from the fact that they distribute air in four directions and downward, are available in a wide range of sizes and capacities. They are especially suited for industrial plants, commercial establishments and large offices.—*Carrier Corporation, Syracuse, N. Y.*

Generators—For use in municipal lighting plants and for industrial emergency power, large a-c generators of from 25 to 2180 kva. for diesel engine drive are described in a new 16-page bulletin announced by Westinghouse Electric & Mfg. Co. Representative installation pic-



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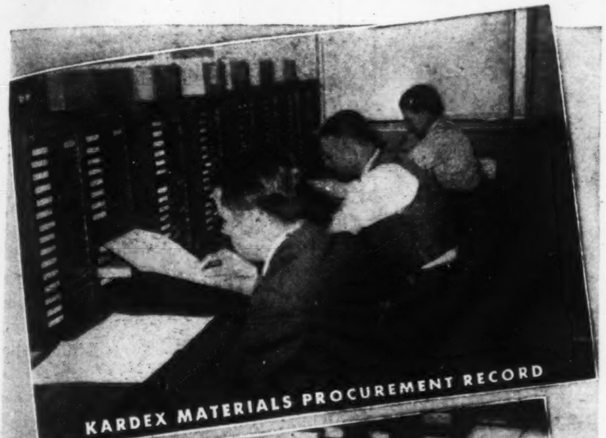

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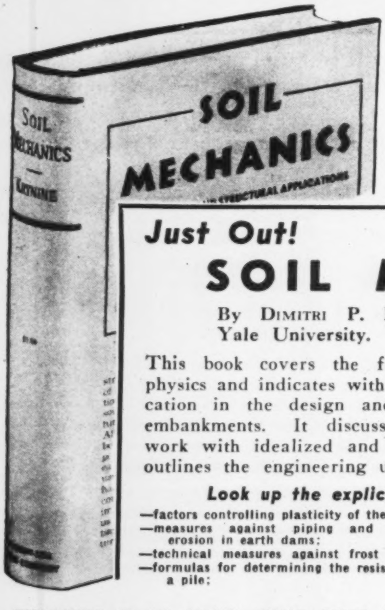

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tures show generators from 2[illegible]9 to 2180 kva. driven by diesel engines.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Truck Mixers—A new catalog, describing the new products of the T. L. Smith Co., manufacturers of mobile concrete mixers, shows details of construction and advantages of new design in the mixers.—*T. L. Smith Co., Milwaukee, Wis.*

Conveyors—The Chain Belt Company has just issued a new Rex bulk handling conveyor catalog, giving information and pictorial descriptions of Rex bulk conveyors, Rex apron conveyors, and Rex bucket elevators.—*Chain Belt Co., Milwaukee, Wis.*

Non-Metallic Bearings—A new catalog describing Gatke molded fabric bearings of various types for grease or oil lubrication, water lubrication, acid-resisting service, and some unlubricated applications, has just been issued. Included are operating characteristics of the various types with performance results on typical applications. —*The Gatke Corporation, 228 No. La Salle St., Chicago, Ill.*

Steel Stock List—Of more than usual interest to steel users is the recently published Joseph T. Ryerson & Son, Inc., 100th anniversary steel stock list. The issuance of this 268-page catalog data book marks the observance by the company of its 100th year of service. The list contains more than 11,000 different kinds, sizes, and shapes of steel bars, shapes, plates, sheets, tubing, coldfinished, alloy, tool and stainless steels, normally carried in stock for immediate shipment.—*Joseph T. Ryerson & Son, Inc., Chicago, Ill.*

Air Raid Shelters—"Air Raid Shelters" is the title of an eight-page circular recently published by the Armco Drainage Products Association. It decribes a corrugated type shelter made to accommodate up to 50 persons, the maximum recommended by the Office of Civilian Defense. The principal type is a 90-in. multi-plate type such as is used for large culverts, bridges and sewers, and its length is in multiples of 2½ ft. It has gas-tight endwalls and a gas lock or chamber can be included during installation or later. An emergency escape tunnel and ventilar opening are in the rear. An economy type of shelter is also provided for individual families.—*The Armco Drainage Products Association, Middletown, Ohio.*

Woodworking—A new booklet describing the DeWalt woodworking machines, which are at present standard equipment on most ships of the U. S. Navy, has been issued by the DeWalt Products Corporation.—*The DeWalt Products Corporation, Lancaster, Pa.*

Heat Insulation—A new 176-page ready reference volume, which includes a comprehensive insulation recommendation section, has been issued by the Ehret Magnesia Manufacturing Co. The insulation handbook also includes a Useful Data Section, containing 24 pages of engineering tables, graphs and definitions of technical terms.—*Ehret Magnesia Manufacturing Co., Inc., Valley Forge, Pa.*

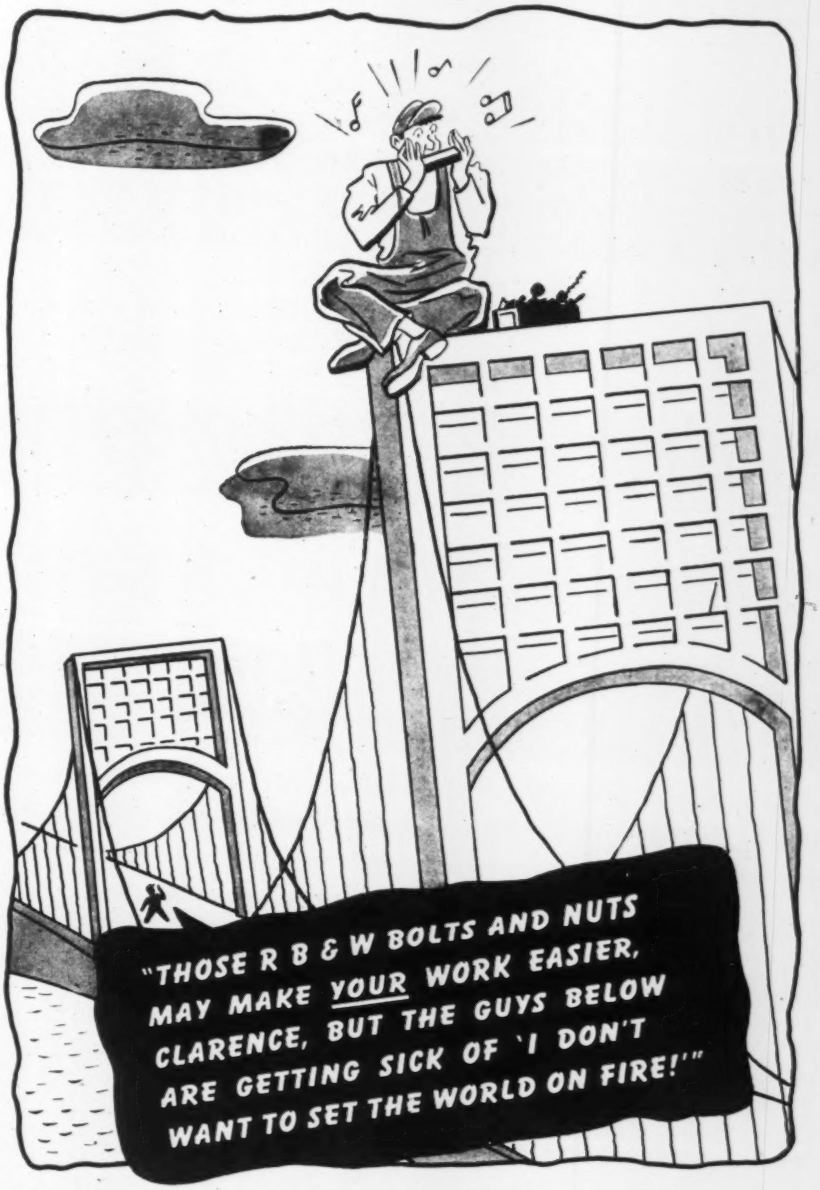
Filters—Design data covering sprinklink filters of separate nozzle field and common nozzle field design, is given in a new filter data book just published by the Pacific Flush Tank Co. Comprehensive charts and tables to assist the consulting and sewage plant engineer in rapidly computing the required filter bed area for a given loading and recommended nozzle spacing is presented. A section deals with the four types of circular spray sewage nozzles of P.F.T. design.—*Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.*

Loader—The Athey MobiLoader is pictured and described in an interesting 12-page booklet just released by the Athey Truss Wheel Company. This booklet shows many applications of both the W4 and the Model 8 loaders in action. A new booklet is also available featuring the new Athey 4-speed loader.—*Athey Truss Wheel Co., 5631 W. 65th St., Chicago, Ill.*

Cutting Tips—An 8-page illustrated booklet just issued by Air Reduction, New York, describes the new Airco "45," high-speed machine cutting tips which increases the speed of flame cutting 20 to 30 percent. Performance facts and figures are described in text and chart form. A table of specifications enables the buyer to tell at a glance the proper tip for their particular needs.—*Air Reduction Sales Co., 60 East 42nd St., New York, N. Y.*

Safe Water—Featuring the statement that home defense starts with health defense and health defense starts with sterilized water, a new booklet describes sterilizing equipment for water supplies.—*Wallace & Tiernan Co. Inc., Newark, N. J.*

Steamboat Ratchets—A new catalog describes the hand forged steamboat ratchet made by Patterson since 1858. An improved model, using shackles instead of welded links to permit replacement of a part, is featured.—*W. W. Patterson Co., 54 Water St., Pittsburgh, Pa.*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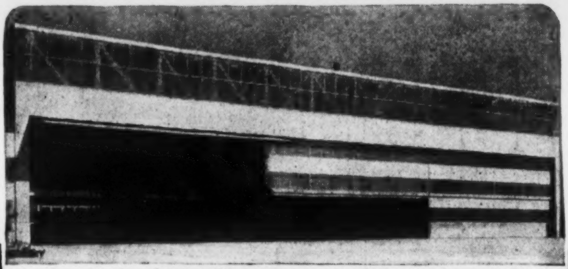

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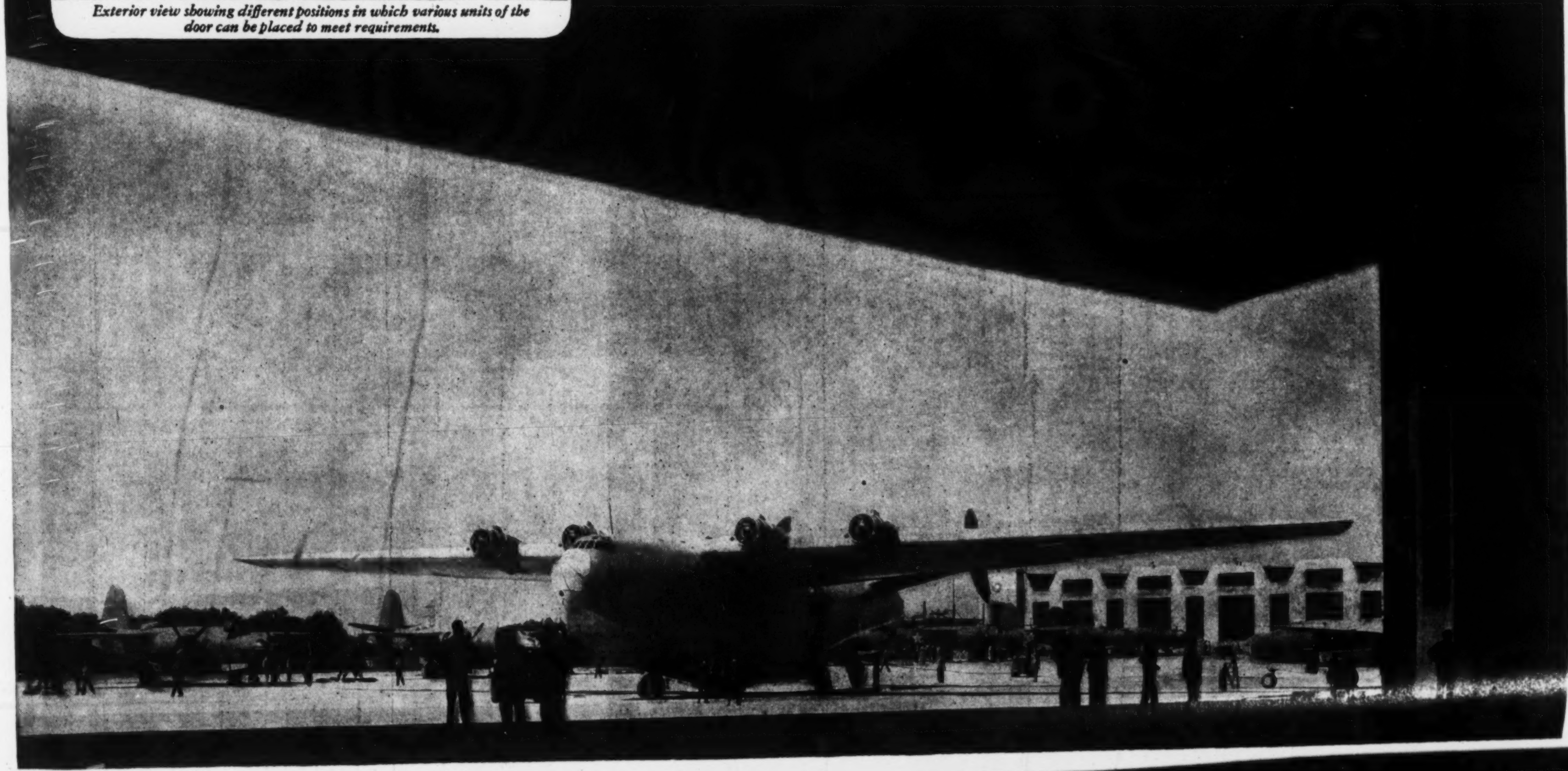TRUSCON Steel BUILDING PRODUCTS